Evaluation of the Foot-and-Mouth Disease Status of the Republic of South Africa

Animal and Plant Health Inspection Service
Veterinary Services
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Abbreviations used in this document

AHT - Animal health technician

APHIS - Animal and Plant Health Service

ASF - African swine fever

CSF - Classical swine fever

DAH - Directorate Animal Health

ELISA - enzyme linked immunosorbent assay

FMD – Foot and mouth disease

FMDV - Foot and mouth disease virus

KNP - Kruger National Park

LBP - Liquid phase blocking

NEO - National executive officer

NFR- National Farmer Register

NSP – Nonstructural protein

NSMAH - National Senior Manager of Animal Health

OIE - World Organization for Animal Health

OVI - Onderstepoort Veterinary Institute

PD - Provincial Director

PEO - Provincial Executive Officer

RSA - Republic of South Africa

RTI - Road Traffic Inspectorate

SANDF - South African National Defense Force

SAPS - South African Police Service

SAT - South African types

SVD - Swine vesicular disease

Definition of the Republic of South Africa foot-and-mouth disease zones

The Republic of South Africa (RSA) has identified three zones within its territory that have a distinct health status with respect to foot-and-mouth disease (FMD) (see Figure 1 for a map illustrating the FMD zones). These three zones, which are separated by geographical and physical barriers and by the application of control and biosecurity measures, are defined as follows:

- Kruger National Park (KNP). The KNP is a national game reserve that is fenced off by a 2.4 meter high, 20-strand electrified fence. The KNP is located in the northeastern part of the RSA and it covers 18,989 square km (7,332 sq mi) and extends 350 km (217 mi) from north to south and 60 km (37 mi) from east to west. FMD is endemic in this zone due to the presence of FMD carrier African buffalo (*Syncerus caffer*).

- Buffer zone. A zone established along the border of the KNP and neighboring countries to prevent spread of FMD into the export zone of the RSA, and created consistent with guidance outlined in Chapter 1.3.5 of the World Organization of Animal Health (OIE) Terrestrial Animal Health Code. The buffer zone consists of two regions that are defined based in the vaccination status of its animals.

    - Buffer zone with vaccination – This zone is comprised of farms that border the western and southern boundary of the KNP where FMD vaccination is conducted. This zone is approximately 350 kilometers long and 10 to 20 kilometers wide.

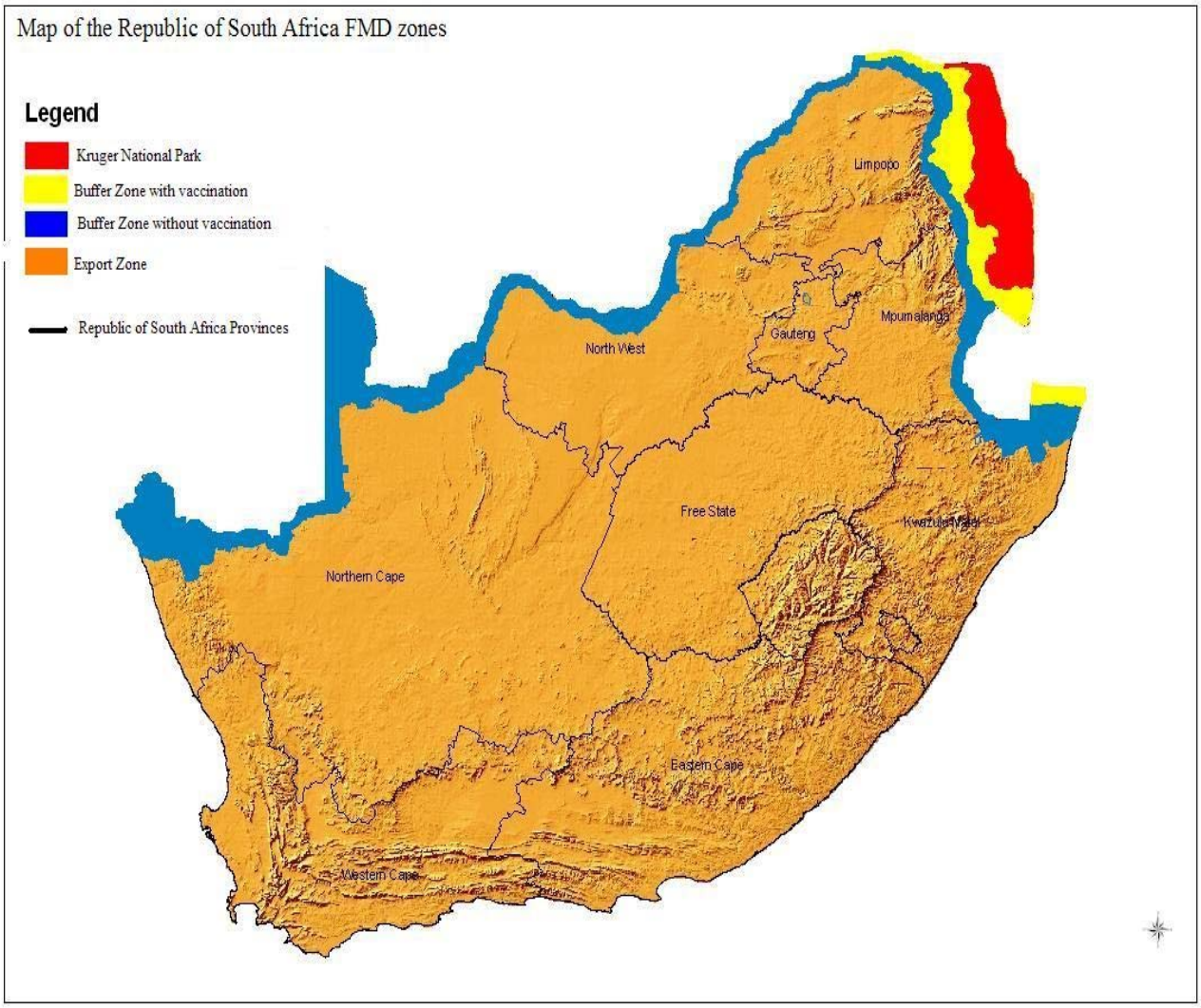
    - Buffer zone without vaccination – This zone is comprised of an area approximately 10 kilometers wide along the national borders of RSA with Swaziland, Botswana, Zimbabwe, and Mozambique and also along the boundaries of the buffer zone with vaccination. FMD vaccination is not allowed in this area.

- The export zone. This zone is the region of the RSA that excludes the FMD-buffer zone and the KNP.

Region under consideration:

The Republic of South Africa.

Figure 1. Map of the Republic of South Africa FMD zones



Glossary of terms

Contract or custom feeding - Situation in which animals of outside customers are fed in a feedlot in addition to those animals obtained by the feedlot for its own business. These animals are sourced from different farmers and from any area of the country.

Direct slaughter – The movement of a potentially infected animal under a red cross permit from the farm of origin to a designated abattoir under strict movement restrictions.

Export zone– The area of the RSA that excludes the FMD-buffer zone and the KNP.

FMD controlled areas - The term is used to be consistent with RSA's Animal Diseases Act of 1984. It is defined as an area where control measures are applied to contain FMD in this area. The controlled areas of the RSA are the KNP and the buffer zone. In the case of an outbreak, the index farm and an area around it (quarantine zone) are also considered FMD controlled areas.

Index farm - The focus of primary disease infection.

Quarantine camp - An animal holding facility that has been approved by a State veterinarian and consists of a double fence of which the two fences are 5 to 25 meters apart.

Quarantine zone - The isolation of disease susceptible animals in an area around the index farm which has been approved by a State veterinarian for a specified period to prevent exposure to or spread of infection; also equivalent to the *focus of infection area*.

Red cross permit – A permit issued only when animals or products to be moved originate from a high risk FMD area and therefore are subject to one or more restrictions en route or at the final destination.

Subpopulation - A distinct part of a population identifiable according to specific common animal health characteristics.

Surveillance zone - An area in which animals are inspected regularly and enhanced surveillance is conducted. In the case of an outbreak, this zone is defined and established around the quarantine zone. This term is used in this document to refer to the enhanced surveillance zone during an outbreak around the quarantine zone.

Executive Summary

In January 1998, the Animal and Plant Health Inspection Service (APHIS) received a request from the Directorate Animal Health (DAH) of the Republic of South Africa (RSA) to recognize the export region of the country as free of foot-and-mouth disease (FMD). On April 17, 2000, APHIS published a final rule recognizing a region of the RSA as free of FMD; this region was the area of the RSA that excludes the FMD-controlled area, which is comprised of the Kruger National Park (KNP) and the FMD buffer zone. This recognition of FMD freedom removed restrictions due to FMD on the importation into the United States of certain live animals and animal products from the region of the RSA that excludes the FMD buffer zone and the KNP. FMD restrictions remained on export of animals and animal products from the buffer zone and the KNP.

On September 15, 2000, the DAH confirmed an outbreak of FMD in the Camperdown district of KwaZulu-Natal Province. This outbreak was located in the region that had been recognized by APHIS as FMD free.

In an effort to prevent the introduction of FMD into the United States, APHIS amended its regulations by regionalizing RSA to remove the KwaZulu-Natal Province from the list of regions eligible to export certain animals, meat, and other animal products to the United States. The interim rule was published in the *Federal Register* on November 2, 2000 [1].

Subsequently, on November 29, 2000, DAH received confirmation of a FMD outbreak in a feedlot in the Middelburg district of Mpumalanga Province. This outbreak was also located in the region that had been recognized by APHIS in April 17, 2000 as free of FMD. As a result, APHIS further amended its regulations to remove all of the RSA from the list of regions considered to be free of FMD. The interim rule removing the RSA from the FMD-free list was published in the *Federal Register* on February 9, 2001 [2].

In its interim rule, APHIS acknowledged that the RSA had responded aggressively to the detections of FMD, and stated its intention to reassess the situation at a future date to determine whether portions of the RSA could be restored to the list of regions considered free of FMD. Accordingly, this current document re-examines the FMD status of the KNP, the buffer zone, and the export zone, including the surveillance and control measures in place in each of these zones. Of particular relevance to this reassessment is the RSA's response to the FMD outbreaks in the export zone in 2000; the sources of these outbreaks; and the measures that have subsequently been implemented to prevent a reoccurrence of FMD in the region previously recognized as free of FMD

As part of its re-evaluation, APHIS conducted a site visit in 2004. In addition to information collected before, during, and after the site visit, APHIS also used documentation submitted by the RSA to the OIE. In this reassessment, APHIS evaluates the FMD control and eradication measures taken and concludes that the DAH was able to effectively detect, contain, and eradicate FMD outbreaks in the export zone. Since December 2000, RSA has not detected any new FMD outbreaks in the export zone.

Since the FMD outbreaks in 2000, the DAH has instituted several changes to its regulations to address factors that led to the outbreaks. These pertain to movement of animals and disposal of international galley waste. In addition, the DAH has reconstructed the fence that separates the KNP from the buffer zone; DAH's personnel acquired experience detecting signs of FMD and handling a FMD emergency; and established appropriate biosecurity procedures to mitigate the risk of FMD transmission. Lastly, the RSA conducted extensive serological surveillance for FMD within the export and buffer zones. Based on the results of the evaluation, the lack of disease recurrence, and the changes made by the DAH, APHIS concluded that the export zone of the RSA could be reinstated to the APHIS list of FMD-free regions.

However, because the export zone of the RSA trades with, and shares common land borders with regions that APHIS does not consider free of FMD, APHIS will require certification to ensure that animals and animal products from the RSA originate in the export zone or in any region that APHIS recognizes as free of FMD, and that prior to export to the United States, the animals and animal products were not commingled with animals and animal products from regions where APHIS considers FMD to exist. Prior to removal from the FMD-free list, APHIS required the same certification criteria.

Despite recognition of FMD freedom, the RSA will not be able to export live swine or fresh pork or pork products to the United States because it has not been evaluated for African swine fever, classical swine fever, and swine vesicular disease.

Based on the results of the release assessment, APHIS could identify no additional risk factors currently applicable to the export zone that would justify keeping this region from the list of regions APHIS considers FMD free.

Regarding the likelihood of exposure of susceptible species in the United States, APHIS conducted an assessment of the potential pathways of exposure due to FMD-infected beef (CEAH 1995 and 2001). APHIS considers that the most likely pathway of exposure of susceptible species to potentially FMD-infected beef would be through feeding food waste to swine (CEAH 2001). Waste-feeder operations in the United States are licensed and inspected regularly by U.S. Department of Agriculture inspectors. The licensing process requires that producers cook the waste fed to swine, reducing the probability of survival of foreign animal disease agents in the waste. In addition, the number of waste-feeding operations declined dramatically since 1994, and several States have prohibited feeding food wastes to swine. APHIS further considers the probability of exposure of susceptible swine to these viruses through inadequately cooked infected meat from the RSA to be low.

The likelihood of exposure of susceptible species to infected live animals was evaluated by briefly reviewing virus persistence and shedding in live swine and ruminants, as well as standard import requirements for these species. Current U.S. regulations require certification that ruminants and swine have been kept in a region entirely free of FMD for 60 days prior to export (9 CFR 93.405 and 93.505) and also require a minimum

quarantine of 30 days for most imported ruminants (9 CFR 93.411) and 15 days for all imported swine (9 CFR 93.510) from the date of arrival at the port of entry. These requirements serve to partially mitigate the risk of exposure by increasing the probability of disease detection.

Based on the results of the release assessment, APHIS considers the probability of exposure of susceptible animals to FMD virus via this pathway to be very low. The importation of live swine into the United States from the RSA would be prohibited because APHIS considers the RSA affected with CSF, SVD, and ASF. Therefore, if trade is reinstated with the RSA, this action would only remove the FMD restrictions from the importation of live ruminants and the likelihood of exposure of susceptible U.S. ruminants or swine to FMD virus via infected ruminants from the RSA is low.

In addition, with the mitigation measures for ruminant and swine embryos and semen listed in 9 CFR 98 subparts A and C, respectively, the likelihood of exposure of susceptible animals to FMD via semen or embryos from the RSA is very low.

Ultimately, the requirements in 9 CFR 94.11 mitigate the risks associated with less restrictive trade practices by (1) restricting the sourcing of ruminants meat for export; (2) prohibiting commingling of live animals, meat, or meat products for export with such commodities from regions not considered free of these diseases; and (3) requiring exporting slaughter establishments to be approved by USDA, Food Safety and Inspection Service. An official veterinarian of the exporting country must certify that these conditions have been met.

Consequence assessments that APHIS conducted previously concluded that the animal health and economic consequences of a FMD outbreak in the United States would be severe. The cost of control, eradication, and compensation, if disease were introduced, is likely to be significant. In addition to the direct costs of FMD introduction, international trade losses would also be significant, even if the disease was rapidly contained and eradicated.

In summary, APHIS considers the risk of FMD-infected animals or products entering the United States from the export zone of the RSA and exposing the U.S. livestock through feeding of infected materials to susceptible animals, to be low. Although consequences of a FMD outbreak in the United States are potentially substantial, the likelihood of an outbreak occurring from exposure of susceptible animals to FMD from imported ruminants and ruminant products from the export zone of the RSA is low.

Objective of the evaluation

This is an analysis of the risk of introducing FMD virus into the United States via live ruminants and ruminant products from the RSA. The risk analysis is intended as a decision-making tool for APHIS managers that will allow them to determine whether a region of the RSA can be reinstated to APHIS list of FMD-free regions, if appropriate regulatory conditions with mitigations to address potential risks of disease introduction

following any reinstatement of trade[1] are applied. The risk analysis also constitutes an information source for APHIS stakeholders, providing justification for re-instating a region of the RSA to the FMD-free list. The release assessment focuses on the FMD outbreaks that occurred, eradication efforts, and control measures applied in the RSA. [3]

The analysis is based on documentation provided by the RSA's DAH, observations made by an APHIS site visit team, and published information. The DAH is the government agency in the RSA responsible for animal health issues.

Hazard Identification

Hazard identification is defined by the World Organization for Animal Health (OIE) as "…the process of identifying the pathogenic agents which could potentially be introduced in the commodity considered for importation", and is a critical component of an import risk analysis. APHIS identified several animal diseases listed by the OIE that pose primary hazards associated with initiating trade in animals and animal products from foreign regions. The listed foreign animal diseases of primary concern are addressed specifically in APHIS regulations. [4, 5]

The hazard identified for the RSA in this assessment is the FMD virus (FMDV), and is recognized by APHIS as a hazard of primary concern. In this regard, before opening or, as in this case, resuming trade in ruminants and ruminant products with a region or country known by APHIS to have been affected with FMD, APHIS conducts an import risk analysis to support rulemaking [6].

This risk analysis considers the risk of introducing FMDV into the United States through the importation of ruminants, ruminant meat, and other meat products of ruminants from the RSA. Epidemiological characteristics of the agent relevant to the import risk it might pose are described in Appendix 1.

Risk Analysis

This risk analysis is composed of a release assessment, exposure assessment, consequence assessment, and risk estimation. These components are defined in OIE guidelines of Chapter 1.3.2, Terrestrial Animal Health Code, and represent the internationally recommended components for animal health import risk analysis.

Release assessment

This release assessment refers to the evaluation of the likelihood that FMD now exists in the regions of the RSA and if so, how likely it would be for the disease to be introduced

[1] A document, titled *Process for Foreign Animal Disease Status Evaluations, Regionalization, Risk Analysis, and Rulemaking*, describes the approach APHIS uses to evaluate regions previously considered free of a disease and that subsequently experienced an outbreak of the disease and then eradicated it [3].

into the United States through imports of ruminants, ruminant meat, and other meat products of ruminants from the export zone of the RSA. This report re-examines the FMD status of the KNP, the buffer zone, and the export zone, including the surveillance and control measures in place in each of these zones. Of particular relevance to this reassessment is the RSA's response to the FMD outbreaks in the export zone in 2000; the sources of these outbreaks; and the measures that have subsequently been implemented to eradicate and to prevent a reoccurrence of FMD in the region previously recognized as free of FMD.

This release assessment presents a discussion and evaluation of the control measures and surveillance in each FMD zone in the RSA, the emergency response capability to outbreaks in each zone, and the effectiveness of measures taken in the buffer zone and the KNP in preventing the entry of FMDV into the export zone. The likelihood will depend on the effectiveness of the eradication and control measures undertaken by the RSA in response to the outbreaks of FMD in the country.

The RSA has identified three zones within its territory that have a distinct health status with respect to FMD. These three zones, which are separated by geographical and physical barriers and by the application of control and biosecurity measures, are the KNP, the buffer zone, and the export zone (i.e., the area of the RSA that excludes the buffer zone and the KNP). The buffer zone includes an area in which FMD vaccination is practiced and an area in which vaccination is prohibited.

Kruger National Park (KNP)

The KNP is a national game reserve located in the northeastern part of the RSA. It covers 18,989 square km, and extends approximately 350 km from north to south and 60 to 80 km from east to west. This national game reserve is fenced off from the remainder of the country (see Figure 1 for a map of the RSA FMD zones including the KNP).

FMD Status of the KNP [7, 8]

FMD is considered by the RSA and the OIE as endemic in the African buffalo population in the KNP. African buffalo are carriers and the principal reservoir of FMD South African types (SAT) 1, 2, and 3.

The African buffalo population in the KNP presents several disease problems to the RSA. In addition to being a reservoir host for FMD, they present diseases such as East Coast fever, tuberculosis, and brucellosis. Because nearly all of the buffalo in the KNP are FMD carriers, depopulation would be impractical as well as unacceptable to the RSA and the KNP.

FMD spreads from the buffalo population when the buffalo calves are about 6 months of age and are weaned. These animals are no longer protected by

colostral immunity and become susceptible to the FMD virus (FMDV). For a short period of time, they shed large amounts of FMDV and pose a risk to other susceptible animals in the park, such as impala.

As an alternative to depopulation, because of the disease risk to livestock in the remainder of the country and the risk of losing the genetic lines of the African buffalo, the RSA has taken steps to build African buffalo FMD-free herds. Several of these herds are located in adjoining game reserves in the buffer zone outside the KNP and are protected with fences similar to those of the KNP.

Control measures in the KNP [9, 10]

FMD is a controlled disease in accordance with the Animal Diseases Act 35/1984 of the RSA. The Regulations promulgated in terms of the Act describe in detail the requirements for disease control to prevent the introduction of the disease in the area considered by the RSA as FMD-free (the export zone). Strict movement control is enforced to prevent the movement of potentially infected and/or vaccinated animals[2] from the KNP to the remainder of the RSA and is reliant on a permit system.

The FMD Control Protocol makes provision for inspections, vaccinations (where applicable) and movement controls in the RSA including the KNP. All veterinary officials and other role-players involved with FMD control must adhere strictly to the protocol. Animal health technicians (AHTs) stationed in the park perform regular game inspections. Game inspections entails the visual observation of game at rest, as well as the individual inspection of game whenever is handled.

As mentioned earlier, FMD is endemic in the KNP and infected buffalo may shed FMDV intermittently or seasonally. The management strategy to decrease exposure of calves to FMDV involves capturing calves at weaning when they are presumably still protected by colostral immunity, isolating the calves from other buffalo, and testing them serologically several times in succession. This is part of DAH's efforts to build African buffalo FMD-free herds and some of these animals are moved to game reserves in the buffer zone with vaccination once it has been determined they are not infected with FMD.

The movement of animals from the export zone into the KNP are allowed under ordinary permit. An ordinary permit is a written authorization used for animal movements and is only issued by a State veterinarian.

Movements from the buffer zone to the KNP are allowed under a red cross permit. A red cross permit is a written authorization and can be only issued by

[2] It is possible that vaccinated animals from the buffer zone could be found in the KNP in exceptional cases, as the result of damages to the fence allowing animals to move from the buffer zone into the KNP, as it occurred during the floods in 2000. This issue is discussed further in subsequent sections of this document.

the State veterinarian after approval of the relevant Provincial Director (PD) or Provincial Executive Officer (PEO) and is used for movement of animals or animal products that are to be moved from a high risk area and therefore are subject to one or more restrictions en route or at destination (see Appendix 2 for details of the restrictions applied to the movement of animal and animal products under a red cross permit). Cloven-hoofed livestock[3] that are moved to the KNP will assume infected status.

There are strict movement controls of live animals and animal products leaving the KNP and these are discussed further in subsequent sections of this document. Movements of animals out of this zone are exceptional and only occur if necessary under strict restrictions to direct slaughter. Direct slaughter entails the movement of a potentially infected animal under a red cross permit from its origin to a designated abattoir under strict movement restrictions described in Appendix 2. Animals are allowed to be slaughtered only at designated abattoirs[4] in the KNP or the buffer zone with a red cross permit after a written approval by the area PD or PEO has been issued, an inspection and oral examination with negative results has been obtained, and a temporary F-brand is visible. The designated abattoirs are not approved for processing of products to be exported.

Within the KNP, cloven-hoofed livestock can be moved with a red cross permit after: a written approval by the area PD or PEO, an oral examination with negative results, a satisfactory inspection, and a permanent F-brand (if applicable).

In addition, there is a veterinary fence used as a FMD control measure in the RSA. This fence separates the KNP from the rest of the country and neighboring countries, and it was established to prevent the spread of FMDV from the infected buffalo populations to the rest of the RSA. This game-proof fence is at least 7.87 feet tall and the bottom 3.28 feet consists of a mesh tightly woven that effectively prevent the movement of small animals through the fence. In addition, the fence is wired and electricity is applied to prevent the movement of animals across the fence. DAH personnel are stationed along the fences to inspect and maintain the fence on a daily basis.

FMD Surveillance in the KNP [7, 9, 10, 11, 12]

Active and passive surveillance are carried out on an ongoing basis within the KNP and adjoining game reserves to monitor the incidence of the disease in wildlife, specifically African buffalo and impala. All diagnostic tests are performed according to the OIE Manual for Diagnostic Tests and Vaccines and

3 Cloven-hoofed livestock refers to cattle, goats, sheep, pigs and exotic cloven-hoofed species including water buffalo and camels. Cloven-hoofed game refers to the families Suidae, Giraffidae and Bovidae of the order Artiodactyla

4 Designated abattoirs are slaughterhouses that are approved by the DAH to slaughter infected or potentially infected livestock from the buffer zone

these are: the liquid phase blocking (LBP) enzyme linked immunosorbent assay (ELISA[5]), the virus neutralization and the nonstructural protein (NSP) 3 ABC ELISA[6] to detect the presence of antibodies to nonstructural proteins on vaccinated animals, virus isolation, and Polymerase Chain Reaction (PCR).

Infected buffalo within KNP may shed FMD virus intermittently or seasonally. For a short period of time, the calves will shed large amounts of virus and pose a risk to other susceptible animals in the park. Within the KNP, impalas act as an indicator species when FMD is active in buffalo. Buffalo have been shown unequivocally to infect impala in the KNP and these animals can in turn spread FMD to livestock in close proximity. Any impala that show signs of lameness and piloerection from fever are evident to observers. These animals are sampled and destroyed for the purpose of tracking virus distribution and type.

AHTs walk through the park on a weekly basis and observe impala for signs of disease. In addition, AHTs collect probang samples from dead buffalo or at any time that buffalo are handled. The geographical origins of isolates from these samples are recorded in a library for reference. The purpose of this procedure is for the DAH to maintain data of the geographical distribution of specific virus serotypes that are circulating at different regions throughout the RSA. Based on nucleotide sequence analysis of a portion of the viral genomes obtained from buffalo and domestic animals within the RSA, several independently evolving viral types of FMDV have been associated with different geographical areas of Africa. For all FMD serotypes, the genetic differences between viruses from different geographical areas is such that outbreaks should be traceable to specific countries, specific game parks, and even to specific regions within game parks, as has been described for the FMD SAT serotypes in southern regions of Africa. This information is also useful to assist in the ability to produce specific vaccines in case that is needed.

Vaccination and animal inspections to allow movements within, in, and or out of the KNP allow veterinarians and AHTs to collect samples that provide data for surveillance. Whenever buffalo are handled for any reason within the KNP, probang and serum samples are taken to monitor infection rate and drift or change in the virus type. Surveillance results have demonstrated that all three SAT types cycle through the buffalo population. Based on a report submitted to the OIE on August 2005, during a strategic survey from August 2004 until July 2005, 206

5 The use of LBP ELISA is of great benefit in areas where FMD prevention, control and eradication programs are carried out. The LPBE provides more reliable results because it is very sensitive and specific. Other advantages are the fast delivery of results (usually within the same day) and the fact that the technique is easy to perform and does not require special laboratory conditions (e.g. cell culture or CO2 environment).

6 This test is an indirect-trapping ELISA which uses a monoclonal antibody to trap the non-structural 3ABC-FMDV polypeptide expressed in E. coli, used to differentiate between vaccinated and infected animals.

buffalo were tested and the results showed the pattern of infection described above.

As to impala, distinct populations in the KNP are sampled on a 3-month cycle. Generally, 30 to 40 animals are clinically examined and bled for testing purposes. Those animals showing clinical signs are euthanized and serum and tissue samples are taken and tested. During the same strategic survey mentioned above, from August 2004 until July 2005, 267 impala were examined and bled. In these animals, DAH did not observe clinical signs or serological evidence of infection.

In addition, based on the report submitted to the OIE on August 2005, from August 2004 until July 2005, the DAH inspected carcasses and collected samples from 27 impala, 3 warthogs, 2 kudu, and one bushbuck that were found dead and found no clinical lesions of FMD and all samples were negative.

FMD Outbreaks in the KNP

FMD is endemic in the KNP.

KNP conclusion: Because FMD is endemic in the KNP, the DAH implemented measures to mitigate the risk of FMDV spread to the remainder of the country. The erection of the veterinary fence, and the strict movement controls implemented appear to be adequate measures to contain FMD in the KNP. Although efforts of the DAH to provide monitoring and maintenance to the fence to prevent transmission of FMD due to contact of cattle with buffalo from the KNP are adequate, damages to the fence occur and outbreaks ocassionally occur in the buffer zone with vaccination. This issue is discussed further in subsequent sections of this document. The ongoing surveillance carried out in the KNP appears to be useful and effective for FMDV traceability purposes, and to produce specific vaccines when needed.

Buffer Zone [7]

A buffer zone was established along the border of the KNP to prevent spread of FMD into the export zone of the RSA and consistent with guidance outlined in Chapter 1.3.5 of the OIE Terrestrial Animal Health Code for zoning. In addition, the buffer zone extends along the national borders of the RSA with neighboring countries. RSA's FMD-buffer zone is comprised of two regions with respect to the vaccination status of its animals. Vaccination of cattle only occurs in the area designated as high-risk by the DAH that borders the KNP (see Figure 1 for a map of the FMD zones in the RSA). As mentioned earlier, this zone is considered high risk due to its proximity to the KNP and damages had occurred and may reoccur to the fence.

- Buffer zone with vaccination – This zone is comprised of farms that border the western and southern boundary of the KNP. Some of the farms in this area are

the focus of DAH efforts to create African buffalo FMD-free herds and are considered by the RSA as provincial game reserves. These herds are protected with fences similar to those of the KNP and in accordance with Nature Conservation Statutory requirements. This zone is approximately 350 kilometers long and 10 to 20 kilometers wide. Strict permit control is enforced in the farms of this zone, routine vaccination is practiced, and intensive FMD surveillance is conducted.

- Buffer Zone without Vaccination – This zone is comprised of an area approximately 10 kilometers wide along the national borders of RSA with Swaziland, Botswana, Zimbabwe, and Mozambique. It also extends along the boundaries of the buffer zone with vaccination. Vaccination is not allowed in this area; however, strict movement controls of live animals and products are enforced.

Buffer Zone with Vaccination

FMD Status in the Buffer Zone with Vaccination [7, 9, 12]

The buffer zone with vaccination is designated by the DAH as a FMD controlled area[7] (as defined by RSA's Animal Diseases Act of 1984) and measures are taken accordingly to prevent the spread of FMDV from the KNP to the remainder of the RSA. Measures include regular inspections, vaccination of animals every 6 months, movement controls and enhanced disease surveillance. However, several FMD outbreaks had occurred within this zone of the RSA after the outbreaks that occurred in the export zone. The DAH reported that the source of infection of the outbreaks in the buffer zone with vaccination have been the direct contact of cattle with African buffalo that occasionally escape from the KNP. The most recent FMD outbreak reported to the OIE occurred on July 31, 2006. Control measures and surveillance in this zone are essential to prevent the introduction of FMDV into the export zone.

Control measures in the FMD Buffer Zone with Vaccination [7, 9, 10, 12, 13, 14]

The buffer zone with vaccination is separated from the KNP by the fence that encloses the national game reserve. There are premises in this zone that maintain African buffalo that are classified by the DAH as Provincial game reserves and are required to have game-proof fences under Regulation 20A of the Animal Diseases Regulations. Regulation 20A lay down the requirements for the registration of farms that maintain African buffalo in the controlled areas, and enforces the erection, patrol, and maintenance of fences to prevent spread of FMD from infected buffalo. These game reserves are inspected by officials and registered with the DAH. In the case that stray buffalo are

[7] The term "controlled areas" is used to be consistent with RSA's Animal Diseases Act of 1984 and is defined as an area where control measures are applied to contain foot-and-mouth disease in this area. The controlled areas of the RSA are the KNP and the buffer zone, but is also used to describe areas where an outbreak occurs and control measures are applied.

found outside the fences they are shot or chased into the relevant Provincial game reserve or into the KNP.

In addition, there are continuous patrols of the fence by veterinary services personnel on foot, bicycle, and/or donkey. Each person has a specific 10 to 15 kilometer section of the fence for which he or she is responsible. They are also able to perform fence repairs that are non-electrical.

Cattle in the buffer zone with vaccination are inspected every 7 days and small stock (i.e. goats, sheep and pigs) every 28 days. These activities are carried out by AHTs under the supervision of a State veterinarian. All cattle, irrespective of age, are vaccinated every 6 months against FMD. Vaccination dates, herd identities and number of cattle vaccinated are recorded. A permanent "F" brand is applied on the right side of the neck of each animal on the day when it is vaccinated for the first time, as well as during future vaccinations if necessary to ensure a clear, legible brand at all times.

Strict permit control is enforced in and out of the zone. Animals that are not F-branded are not allowed to be moved out of the zone. Movement of cloven-hoofed livestock from this zone to slaughter is allowed only to designated abattoirs in the buffer zone or the KNP only, with a red cross permit. It is required to have a written approval by the area PD or PEO, a satisfactory inspection and vaccination history (if cattle), and a permanent or temporary F-brand (if cattle).

Within the buffer zone with vaccination, cloven-hoofed livestock can be moved with a red cross permit after: a written approval by the area PD or PEO has been issued, there is proof of an oral examination with negative results, there is proof of a satisfactory inspection and vaccination history (if cattle), and a permanent F-brand (if cattle).

For movement of cloven-hoofed livestock from the KNP into this zone, in addition to the above, a full clinical and oral examination must be performed at the time the movement is to occur. In addition, an inspection of the remaining animals of the herd must be performed twice within 7 days previous to the date the movement is to occur with no signs of clinical disease (if applicable), and the entire herd must have been vaccinated (if applicable). As mentioned earlier, these movements are exceptional.

Movements of cloven-hoofed livestock from the remainder of the RSA (excluding the KNP) into this zone are allowed under ordinary permit.

Cloven-hoofed game other than buffalo may be moved from the KNP into this zone with a written approval of the relevant PD only if: animals are quarantined in an approved quarantine camp[8] in the KNP or the buffer zone, all animals are identified individually, and all animals in quarantine show negative serological results for FMD after 21 days in

[8] A quarantine camp is an animal holding facility that has been approved by a State veterinarian and consists of a double fence of which the two fences are 5 to 25 meters apart. Such camp must have its own water supply. The animal free-zone between the two fences must be kept free of susceptible animals at all times during quarantine, and must be kept debushed at all times to facilitate inspection.

quarantine. In addition, the animals must spend 30 days in a game-proof camp[9] at the final destination where are inspected regularly.

Movement of cloven-hoofed game other than buffalo from the buffer zone without vaccination to the buffer zone with vaccination is allowed with a red cross permit with a written approval by the area PD.

Goats and sheep may be moved from FMD-infected areas[10] to the buffer zone for direct slaughter for local consumption only after the herd of origin has been inspected at least once with negative results within the last 28 days, and another inspection is performed at the time of movement.

In the case of an outbreak, the area where the outbreak occurs is quarantined and roadblocks leading out of the focus of infection are established to control movement from the infected premises. In addition, a surveillance zone with a radius of at least 10 kilometers is established around the quarantine zone.

FMD Surveillance in the Buffer zone with Vaccination [7, 10]

Surveillance activities are carried out by AHTs under the supervision of a State veterinarian and provide information on the immune status of animals within the zone. Surveillance in this zone includes the use of the LPB ELISA and the NSP ELISA (3 ABC ELISA) to detect the presence of antibodies to nonstructural proteins in the vaccinated animals. Farm visits by veterinarians and AHTs, as well as samples taken during vaccinations and meat inspections at abattoirs provide additional data for surveillance. In addition, serum samples are taken and submitted for testing prior to the movement of animals and game to be moved out of the buffer zone. Cattle are inspected every 7 days. Goats, sheep, and pigs are inspected every 28 days.

From 2000 to 2005, the DAH conducted special surveys throughout the RSA to provide evidence of the absence of the FMDV on the surveyed population. The most recent survey conducted in the buffer zone with vaccination focused on samples taken in the area around the Mopani District in the Limpopo Province, where an FMD outbreak occurred in 2004. Details of the surveillance as a result of the outbreaks are explained further in the subsequent section that describe the outbreaks and measures taken by the RSA to control the outbreaks.

FMD Outbreaks in the Buffer Zone with Vaccination [7, 10, 13, 14, 15]

Nkomazi Outbreak

The Nkomazi State Veterinary area is located between the southern borders of the KNP, Mozambique, and Swaziland and forms part of the Mpumalanga Province.

9 A game-proof camp is an approved quarantine camp with two game-proof fences 5 to 25 meters apart.

10 FMD infected areas refers to any area in which an outbreaks had occured and control measures are applied, in addition to the FMD endemic KNP

There is only one port of entry into and out of the area along a national highway. There are mountains on the southern, western and eastern borders and the Crocodile River to the north. All of these are natural barriers between this area and the remainder of the RSA.

As a result of trace-back actions following the outbreak that occurred in the district of Middelburg, Mpumalanga Province in November 2000, the DAH identified an outbreak in the municipality of Nkomazi (the outbreak in the Middelburg district is explained in more detail in the discussion of the outbreaks in the export zone). The FMD outbreak in Nkomazi was caused by buffalo/cattle contact in the Lowveld area of the municipality, bordering the southern KNP (see Figure 2 for a map that illustrates the results of the FMD tracing investigations in the RSA including the Nkomazi outbreak).

Stray buffalo movements were observed outside the KNP after devastating floods in the first quarter of 2000 produced severe damages to the southern and western KNP fence. Suspect lesions were detected on cattle and infection was later confirmed by the OVI. As a result of the FMDV confirmation in the district of Middelburg all movements of animals from the Nkomazi State veterinary areas were stopped. A Joint Operational Committee was established within 24 hours consisting of National and Provincial Veterinary Services personnel, officials of the South African National Defense Force (SANDF), the South African Police Services (SAPS), the Road Traffic Inspectorate (RTI), and industry organizations. Officials of the SANDF, SAPS, and RTI assisted in three roadblocks that were established to control animal and animal products movements.

Officials chose movement controls with defined quarantine and surveillance zones, and emergency vaccination as the primary control measures. Stamping out was not considered a necessary option because the geographical distribution and sociopolitical implications of the outbreak. The outbreak was located in Nkomazi which is part of the buffer zone with vaccination and therefore emergency vaccination to reduce the spread of the disease would not affect the FMD status of the region. Movement controls were based on protocols written by veterinary officials and defined and established a quarantine zone of a 10-kilometer radius and a 30-kilometer radius surveillance zone around the primary focus of infection. Informational pamphlets describing movement restrictions were distributed to farmers and the general public of the area.

On December 15, 2000, results of testing indicated the possibility of FMD infection in cattle on four premises; however, there were no clinical signs observed. On the same day, FMD was confirmed based on specimens from lesions in cattle taken at a communal diptank. FMDV SAT-1 was isolated and was closely related to the feedlot virus and viruses isolated from buffalo in the southern portion of KNP. Afterwards, serological evidence of previous infection was obtained on five additional premises and 12 communal diptanks all within the Nkomazi State Veterinary area.

Clinical and serological surveillance continued in cattle, goats, sheep, and pigs on all farms, communal diptanks, and some impalas in the quarantine and surveillance zones of the outbreak.

Veterinary officials started an emergency vaccination of cattle, goats, and sheep within the focus of infection area when FMD was diagnosed on December 15. Cattle were vaccinated 4 weeks later with a trivalent vaccine. Vaccination coverage in cattle was 89 and 83 percent, and vaccination coverage of goats and sheep was 74 and 63 percent, respectively. Vaccine reaction in the focus of infection area was assessed serologically in cattle. Seventy-three percent of samples tested positive with LPB ELISA demonstrating a serological response to the vaccine.

From December 15, 2000 to the end of March 2001, veterinary officials inspected 714,804 cattle; 18,402 goats; 3,488 sheep; and 16,034 pigs. During this period 9,262 serum samples were collected from cattle, 2,794 from goats, 83 from sheep, 122 from pigs and 54 from impala. In addition, 51 tissue samples were collected from cattle. All tests were done at the Exotic Diseases Division of the OVI in Pretoria. Serum samples were tested using the LPB ELISA. Samples that tested positive to LPB ELISA were then tested using the 3ABC ELISA following OIE guidelines for the surveillance of FMD vaccinated animals. The 3ABC ELISA is a nonstructural protein test and can detect antibodies to all serotypes of FMDV. Animals vaccinated and subsequently infected with FMDV develop antibodies to nonstructural proteins which are captured by the 3 ABC ELISA test. Results of 3 ABC ELISA tests provided the DAH with data to determine if the virus was circulating. In addition, tissue samples were tested by using typing ELISA, PCR, and virus isolation.

Direct slaughter of cattle at approved abattoirs was allowed. The heads, feet, and offal were moved to the focus of infection or destroyed under supervision. Movements of vaccinated animals from the focus of infection were only allowed for slaughter. The DAH determined that virus was not circulating and emergency vaccination within the quarantine zone was suspended and the last roadblock was lifted on March 31, 2001. The routine vaccination of cattle in the buffer zone with vaccination continued as scheduled and an additional area was identified and routine vaccination was applied due to risk of potential contact between stray buffalo and cattle, pending completion of construction of the veterinary fence that was taking place.

Mhala District in Limpopo Province Outbreak

On the 1st of February 2001, FMD lesions were detected in cattle at a dipping tank in the Bushbuckridge area of the Mhala district, of the Limpopo Province that borders the KNP (see Figure 2 for a map that illustrates the results of the FMDV tracing investigations). The DAH reported that the most likely cause of

the outbreak was contact between stray buffalo and cattle, following damage to the KNP fence after the floods. In this case, the FMDV SAT 2 was diagnosed as the causative virus.

The same control strategy applied during the outbreak in Nkomazi was followed, with quarantine, emergency vaccinations, strict movement control and surveillance. The entire Bushbuckridge area was placed under quarantine and no cloven-hoofed animals or animal products were allowed to leave the focus of infection. Seven roadblocks on roads leaving the area were established and monitored by veterinary officials, SANDF, SAPS and RTI officials. Movements of products for consumption were allowed into and within the area on a closely monitored permit system.

On February 5, 2001, a first round of emergency vaccinations was started. A second round of vaccinations was conducted four weeks later.

Surveillance was conducted in the primary focus of infection and in a 10-kilometer surveillance zone around it. Weekly inspections of all animals were conducted. Within the first two weeks in February, random sampling of cattle in all dip tank areas and farms (119) in the focus of infection area was conducted. A total of 2,858 serum samples were taken and tested using LPB ELISA and a total of 119 tissue samples were taken and tested by using typing ELISA, PCR and virus isolation. A total of 27 samples tested positive for typing ELISA.

In the surveillance zone, samples from cattle were taken and tested negative on the LPB ELISA, providing evidence that the infection did not spread out of the focus of infection area. Animals in the Bushbuckridge area were vaccinated for a third time during July 2001. The emergency restrictions and control measures applied during the outbreak were lifted on August 30, 2001, and normal control measures of the buffer zone with vaccination were restored. Vaccinations were restored to the regular schedule as respective to the buffer zone with vaccination in November 2001 and March 2002.

Mutale District in Limpopo Province Outbreak

On August 8, 2003, veterinary officials of the Mutale District, Limpopo Province, received reports of sick animals. One of the livestock owners complained of severe foot problems and lameness in his cattle. An AHT discovered suspicious oral lesions and reported the incident to the local State veterinarian. An investigation was started and samples submitted to the OVI. FMDV was confirmed and the virus isolated was SAT 2, one of the serotypes that is found in buffalo in the KNP. The DAH believes that the source of infection was due to direct contact of cattle with buffalo of the game reserve (see Figure 3 for a map illustrating the locations of the outbreaks).

The same control strategy applied in Nkomazi and Mhala was used during this outbreak by establishing quarantine and surveillance zones, control measures such

as roadblocks for movement control, emergency vaccination, inspection and surveillance. No animals or animal products were allowed to leave the focus of infection area. Movements of products for own consumption were allowed into and within the area on a closely monitored permit system. No new FMD cases were observed and the outbreak was officially declared ended by the end of October 2003.

Mopani District in Limpopo Province Outbreak

On June 26, 2004, FMD was detected in cattle of two dip tank areas of the Limpopo Province. The diagnosis was confirmed as FMDV SAT 2 by the OVI and the DAH believes that the source of infection was direct contact of cattle with buffalo of the game reserve. DAH conducted inspections and emergency vaccination of susceptible animals in the outbreak area immediately upon detection of the disease. Veterinary officials defined a quarantine zone and established roadblocks, movement controls, and a surveillance area in a 10 kilometers radius around the quarantine zone.

Due to the discovery of new cases in other farms in the area, the quarantine zone was enlarged. In addition, the surveillance area was enlarged to a 15 to 30 kilometer radius around the quarantine area, accordingly. This resulted in 2/3 of the Mopani District being enclosed within the surveillance area (see Figure 4 for a map illustrating the quarantine and surveillance zones).

During the period of the outbreak, a total of 37 known infected epidemiological units (31 communal dip tanks and 6 commercial farms) were confirmed. All were within the quarantine area. There was a complete embargo on movement of cloven-hoofed animals and their products.

Movement controls in the quarantine and surveillance areas were monitored by roadblocks maintained by SAPS, SANDF, and TRI personnel. In addition, veterinary personnel conducted regular inspections, verification of stock registers, and extension activities. An official movement control protocol that defined control measures for the movement of cloven-hoofed animals and their products was created.

The DAH provided outreach to the community during community meetings, meetings with the livestock farmers association, broadcasting information and conducting interviews on local radio stations, using agricultural extension officers, and distribution of 60,000 pamphlets with information about FMD.

The DAH stated that the needs for controlling the outbreak exceeded the capacity of the Limpopo provincial government, the National Veterinary Services and the Department of Agriculture officials. As a result, additional officials from other provinces had to be deployed to the outbreak area. A total of 403 agriculture

officials (State veterinarians, animal health technicians, extension officers, and support personnel) were used.

The last two FMDV-positive results were reported on November 12, 2004. Emergency movement controls were lifted and the outbreak was officially declared ended on February 19, 2005.

Malamulele, Limpopo Province Outbreak

On July 31, 2006, the DAH identified FMD in cattle of two dipping tanks in a communal farming area of Matiani next to the KNP (see Figure 5 for a map with the location of the outbreak). The OVI confirmed FMDV SAT 3 and the DAH believes that the source of infection was due to direct contact of cattle with buffalo of the game reserve. A portion of the KNP fence was not secure in the area due to construction work conducted on the fence. Eleven animals out of a group of 45 were found to be infected. The outbreak area was quarantined and roadblocks were implemented to apply strict movement controls. The DAH conducted inspections and emergency vaccinations of susceptible animals in the outbreak area immediately upon detection of the outbreak. After two rounds of vaccinations and inspection of 100% of the cattle's mouths, as well as mandatory weekly inspections at all dipping tanks without additional clinical cases found, the outbreak was declared ended on November 23, 2006.

Buffer zone with vaccination conclusion: The buffer zone with vaccination provides mitigation to the transmission of FMDV from the endemic KNP to susceptible animals in the export zone. This risk is further mitigated with the creation of a buffer zone without vaccination along boundaries of the buffer zone with vaccination and the enforcement of strict movement controls amongst zones. In addition, the buffer zone with vaccination is separated from the KNP by a game proof fence. The integrity of this physical barrier was affected by floods in 2000; however, the RSA was able to correct the damages and improved the fence. Although efforts of the DAH to provide monitoring and maintenance to the fence to prevent transmission of FMD due to contact of cattle with buffalo from the KNP are adequate, damages to the fence occur and outbreaks occasionally recur in the buffer zone with vaccination

FMD was not initially detected in animals in the Nkomazi area; it was detected as a result of the investigation of the Middelburg outbreak in the export zone which indicated Nkomazi animals as the origin of the disease (this outbreak is further described in subsequent sections of this document). It appears that the industry and animal health authorities of the area lacked experience recognizing signs of FMD. However, once FMD was confirmed, the response to the outbreak was prompt and the DAH took adequate control measures that were effective containing the disease. In addition, as a result of the experience acquired during this outbreak, further outbreaks in this zone were quickly detected and adequately controlled.

The possibility that vaccination masks FMD exists; however, a serosurveillance is conducted using 3 ABC ELISA tests to detect antibodies to nonstructural proteins providing evidence after an outbreak that FMDV is no longer circulating within the zone, in addition to the further clinical and epidemiological investigation of animals.

Buffer Zone without Vaccination

FMD Status in the Buffer Zone without Vaccination [7]

This zone is comprised of an area 10 kilometers wide along the national borders of the RSA with Swaziland, Botswana, Zimbabwe, and Mozambique and extends along the boundaries of the buffer zone with vaccination. Cattle in this zone are not vaccinated, and therefore, act as sentinels between the buffer zone with vaccination and the remainder of the RSA. This zone was established following guidelines provided in Chapter 1.3.5 of the OIE Terrestrial Animal Health Code to establish a FMD free zone in a country with an infected zone and a zone where vaccination is applied. Control measures such as regular inspections and movement controls are carried out in this zone and all FMD-susceptible animals are subject to enhanced surveillance. (See Figure 1 for a map illustrating the FMD zones in the RSA)

Control Measures in the Buffer Zone without Vaccination [7, 10]

The focus and depth of the control measures in the buffer zone without vaccination varies within the zone depending on the proximity of farms to the buffer zone with vaccination. Control measures in the area that extends along the boundaries of the buffer zone with vaccination are designed to restrict the entry of vaccinated animals into the buffer zone without vaccination. Control measures in the area of this zone adjacent to neighboring countries are specifically designed for border animal health risk control. DAH officials inspect cattle in the area that extends along the boundaries of the buffer zone with vaccination every 14 days. Cattle inspections in the remainder of the zone (i.e. area adjacent to neighboring countries) are carried out every 28 days. Goats and sheep in the entire buffer zone without vaccination are inspected every 28 days irrespective of the proximity to the buffer zone with vaccination.

Movements of African buffalo from the KNP or the buffer zone with vaccination are not allowed into the buffer zone without vaccination. Movements of cloven-hoofed livestock from the export zone into the buffer zone without vaccination are allowed under ordinary permit. Movements of cloven-hoofed livestock within the buffer zone without vaccination are allowed with: a written approval of the area PD or PEO, an oral examination with negative results, and proof of an inspection history.

Movements of cloven-hoofed animals from the KNP into this zone are only allowed with a red cross permit after: a written approval by the area PD or PEO has been issued, an oral examination with negative results has been performed, proof of a satisfactory inspection and vaccination history (for cattle if applicable) was presented, and a visible permanent F-brand (for cattle if applicable). In addition, a full clinical and oral

examination must be performed at the time the movement is to occur. It is also required that the animals undergo a 21-day quarantine in the KNP previous to the movement. As mentioned earlier, these types of movements are exceptional and only occur if necessary under strict restrictions.

Movements of cloven-hoofed livestock from the buffer zone with vaccination into this zone are allowed with a red cross permit after: a written approval by the area PD or PEO has been issued, completion of 21-day quarantine in the buffer zone with vaccination, and an oral examination with negative results has been performed. In addition, movement of cattle is allowed with: evidence of a satisfactory inspection and vaccination history, a permanent F-brand, the entire herd of origin must have been vaccinated.

Movements of cloven-hoofed livestock for slaughter are allowed from the buffer zone with vaccination into this zone only to designated abattoirs with a red cross permit. In addition, they must have a written approval by the area PD or PEO, a satisfactory inspection and vaccination history (if cattle), and a permanent or temporary F-brand (if cattle).

Movements of cloven-hoofed game other than buffalo from any zone into this zone are allowed with: a written approval by the area PD or PEO, proof of a 21-days quarantine in an approved quarantine camp, and proof of a negative serology after the quarantine period for all three SAT serotypes. In addition animals must be identified individually and must be retained for 30 days in a game-proof camp at the final destination.

The movement of cloven hoofed livestock products that are not originated from an approved abattoir is allowed only after a permit has been issued. The movement of cloven hoofed game products is only allowed after a permit has been issued under more restrictive measures than those for cloven hoofed livestock products to ensure that these products have been processed in a manner that would inactivate the FMDV if present.

Movement of goats and sheep are allowed from the buffer zone with vaccination into this zone for slaughter if the whole herd of origin has been inspected at least once in the previous 28 days of the date the movement is to occur.

If an outbreak occurs in the buffer zone without vaccination, isolation of infected animals and ring vaccination would be used. Quarantine and isolation of the infected animals or farms would be established with the use of cordons and roadblocks leading out of the focus of infection area to control movement from the infected premises. In addition, a surveillance zone with a radius of at least 10 kilometers would be established around the quarantine zone.

FMD Surveillance in the Buffer Zone without Vaccination [7]

Farm visits and inspections by Veterinarians and AHTs, as well as ante- and postmortem inspections at abattoirs provide an additional opportunity to do surveillance for FMD. All suspect cases reported by farmers or picked up by field personnel are clinically examined and blood and tissue samples are taken for FMDV detection. In addition,

serum samples are taken and submitted for testing prior to the movement of animals and game from this zone.

The DAH has conducted special surveys throughout the RSA including the buffer zone without vaccination, to demonstrate that the FMDV did not spread from the outbreak-affected areas to other areas of the country. A strategic survey was conducted during June and August 2005 where a number of samples were taken, in their majority in the buffer zone areas (see Figure 6 for a map indicating the sampling points). The survey was designed to prove the absence of FMD infected or FMD vaccinated cattle in high risk sampling points around the KNP and on borders with neighboring countries. A total of 8,058 samples were tested using LPB ELISA. As mentioned earlier, positive test results were followed up using using 3ABC ELISA to confirm false-positive results to substantiate freedom of infection.

FMD Outbreaks in the Buffer Zone without Vaccination

There is no recent history or evidence of FMD outbreaks in this zone.

Buffer zone without vaccination conclusion: Control measures were developed emphasizing strict movement controls between zones and it appears its application is effective. Animal inspection schedules are designed appropriately taking in consideration the proximity of farms in this zone to national borders or to the buffer zone with vaccination, and the frequency of inspections appears to be sufficient. In addition, FMD surveillance programs appear to be adequate to detect infection in non-vaccinated animals of this zone and would detect the presence of vaccinated animals. Considering the experience acquired during the outbreaks in 2000 in the export zone (further described in subsequent sections of this document), it is considered that the DAH will be able to detect and control FMD if it were to occur in this zone.

The buffer zone without vaccination provides further mitigation to the possible transmission of FMDV from the endemic KNP to susceptible animals in the export zone. In addition, animals in this zone act as sentinels between the buffer zone with vaccination and the export zone. Furthermore, it mitigates the risk of introduction of FMD from neighboring countries into the export zone

Export zone (i.e., the area of the RSA that excludes the buffer zone and the KNP)

FMD Status in the export zone [7, 16]

The zones excluded from the area that is discussed in this section are the endemically infected KNP and the buffer zone. This region is the export zone of the RSA and is considered by the DAH as FMD-free. Control measures are taken accordingly to prevent the introduction of FMDV into this area from the KNP; however, two FMD outbreaks occurred within this area of the RSA. In September 2000 a case of FMDV Serotype O was diagnosed in a piggery in KwaZulu-Natal after the illegal feeding of untreated swill.

In November 2000, an outbreak of FMDV SAT 1 was diagnosed in a feedlot in the Mpumalanga Province. This outbreak was traced back to cattle in an area of the buffer zone with vaccination south of the KNP after the game-proof fence surrounding the KNP was severely damaged by floods as described in previous sections of this document. In both occasions, the DAH initiated an emergency vaccination of all cattle, sheep and pigs in the infected feedlots. In addition, quarantine and surveillance zones were defined and strict movement controls were implemented. The implementation of these measures prevented further spread of the FMDV to other areas of the RSA. No further clinical cases were observed and all emergency restrictions applied during the outbreaks were lifted on March 31, 2001. All animals that were vaccinated during the outbreaks were slaughtered by the end of 2002.

Control measures in the export zone [7, 10, 12, 14, 15, 16, 17]

Control measures in this area are aimed at preventing the introduction of FMDV from the KNP and neighboring countries. Vaccination is not allowed in this area; however, limited ring vaccination is allowed in the case of an outbreak when depopulation of a large number of animals is not an option to the DAH. Control measures taken as a result of an outbreak are further described in a subsequent section that discusses the outbreaks that occurred in this area.

The movement of cattle and small stock within the export zone does not require a veterinary permit. However, a written approval from the National Senior Manager Animal Health (NSMAH) or the National Executive Officer (NEO) is required for the movement of cloven-hoofed game. In addition, all game movements are controlled by Provincial Nature Conservation authorities in collaboration with the Provincial veterinary services.

There are strict restrictions for movement of animals and animal products into the export zone. The movement of cloven-hoofed game other than buffalo from the KNP into this area is allowed only after: a written approval of the area PD, proof that the animals were quarantined in an approved quarantine camp in the KNP, and proof of negative serological results for FMD after the completion of a 21-days quarantine. In addition, these animals must be identified individually and must be quarantined for 30 days in a game-proof camp at the final destination.

The movement of “F” branded animals from the KNP or the buffer zone with vaccination into this area requires the approval of the NSMAH or the NEO, in consultation with the area PD or the PEO. These movements are exceptional and only occur if necessary under strict restrictions to direct slaughter.

The movement of cloven-hoofed livestock (with the exception of animals in transit to be slaughtered) from the buffer zone without vaccination into this area is only allowed after: a written approval of the PD or PEO has been issued, proof of a no-vaccination history is presented and no visible sign of a “F” brand, a satisfactory inspection history is presented, an individual identification of the animals, proof of a 21-day quarantine in an

approved quarantine camp in the buffer zone is presented, proof of a negative serology for all three SAT serotypes after completion of a 21-days quarantine is presented, and an oral examination after 21 days in quarantine is conducted. Movements to the quarantine camp require a red cross permit and movements from the quarantine camp to the final destination require an ordinary permit.

The movement of cloven-hoofed game from the buffer zone (with or without vaccination) into this area is only allowed after: a written approval of the PD or PEO has been issued, an individual identification of the animals, proof of a 21-days quarantine in an approved quarantine camp in the buffer zone is presented, and proof of a negative serology for all 3 SAT serotypes after 21 days in quarantine is presented. In addition, these animals must be retained for 30 days in a game-proof camp at the final destination.

In addition, the RSA maintains a National Animal Disease Database, where information regarding suspect cases of FMD is entered and monthly reports are compiled to record and prompt animal disease reporting. Emergency reporting takes place whenever there is a suspected outbreak of FMD.

FMD Surveillance in the export zone [7]

The DAH performs surveillance of animals presented for export, on farms, and in slaughterhouses. In addition, RSA's trading partners require FMD testing of cloven-hoofed animals, including cloven-hoofed game animals, prior to export. This testing provides the RSA with information as to the FMD status of those animals. Also, veterinarians submit samples for FMD testing when investigating disease or dead animals in farms, and State veterinarians and AHTs conduct farm visits when needed to conduct examinations of animals. Furthermore, officials inspect animals for FMD lesions at slaughter.

An active surveillance is conducted in the case of an outbreak to evaluate the situation and demonstrate eradication of the outbreak. Active surveillance during the 2000/2001 outbreaks is further described in subsequent sections.

FMD Outbreaks in the export zone [7, 10, 12, 13, 15, 16, 17]

In September 2000 the OVI diagnosed a case of FMDV serotype O in a piggery in KwaZulu-Natal after the illegal feeding of untreated swill. KwaZulu-Natal is one of nine provinces of the RSA located in the eastern part of the country (see Figure 7 for a map illustrating the location of the KwaZulu-Natal Province).

Two months later, in November 2000, an outbreak of FMD caused by serotype SAT 1 was diagnosed in a feedlot in the Mpumalanga Province. The SAT 1 outbreak was traced to cattle in the FMD Buffer zone with vaccination south of the KNP after the game-proof fence surrounding the KNP was severely damaged by floods. This enabled buffalo to come into direct contact with cattle outside the KNP (see Figure 8 for a map of the Mpumalanga Province). The DAH used control strategies designed specifically to contain each of these FMD outbreaks.

Camperdown District in KwaZulu-Natal Province

Synopsis of the outbreak in Camperdown District, KwaZulu-Natal Province [7, 12, 16]

On September 7, 2000, a private veterinarian investigated high mortality in pigs on a farm in Camperdown district due to suspicion of poisoning with pesticide from containers in which food was stored. The mortality in pigs was thought initially to be due to poisoning because the containers had previously stored dichlorvos[11] which can cause signs similar to those of FMD. Vesicular lesions were eventually detected and the local State veterinarian was contacted. Samples were collected on September 14, 2000, and confirmed as positive for FMD at the Exotic Diseases Division of OVI on September 15, 2000. The Institute confirmed the samples as positive for FMD serotype O. Serotype O had never occurred in South Africa.

Within 36 hours of OVI's FMDV confirmation, an FMD-control center to manage the emergency was established outside the primary focus of infection at Pietermaritzburg, a Province next to KwaZulu-Natal (see Figure 7). Trace backs and culling of infected animals was begun. In addition, a Joint Operational Committee was formed consisting of officials of the SANDF and SAPS to assist in control measures.

Veterinary officials traced the source of the outbreak to illegal swill fed to pigs. Investigation results found that the illegal swill was derived from international galley waste from Durban Harbour (see Figure 2 for a map illustrating the results of the tracing investigation). In the RSA, swill of local origin can be fed to pigs only if pre-boiled for at least 60 minutes or sterilized in another efficient manner. However, swill of international origin is prohibited. Records showed that more than 350 ships were present at the harbor within 4 weeks of the possible infection of the pigs. Veterinary officials were unable to identify the country of origin and the ship.

The farms immediately surrounding the index farm were inspected daily for possible spread of disease and quarantine notices were imposed. A 10-kilometer quarantine zone and a 30-kilometer surveillance zone surrounding the index farm were established. Veterinary officials determined that disease at the farm was identified in the early stages of the outbreak because the piggery was the index farm and the secondary outbreaks that were identified by surveillance were not widespread.

[11] Dichlorvos is an insecticide which is used to control insects primarily in storage areas and barns. It can affect the nervous system where it may cause nausea and vomiting, restlessness, sweating, and muscle tremors at high levels.

The Camperdown district and 15 other districts were placed under quarantine and Veterinary Services officials established movement controls of animals and animal products into and out of the quarantine and surveillance. The DAH declared this area as a controlled zone and applied restrictions appropriate to RSA's regulations for controlled zones. No animals were allowed to be moved into or out of the zone.

On September 20, veterinary officials detected fresh clinical lesions in bovines in the surveillance zone and confirmed the infection to be positive for serotype O. Veterinary officials culled all animals on this farm and depopulated all cloven-hoofed animals on 14 farms within a radius of 3 kilometers of the original infection. Culling operations commenced on September 21 and were completed on October 1.

On October 10, infection was detected as the disease spread on a farm located within the 10 kilometer quarantine zone. Spread was thought to be due to patronage by workers from other farms and some personnel working on the outbreak at a local pub located on the premises of the index farm. On October 11, Veterinary Services officials depopulated all livestock on the farm.

On October 23, infection was detected as part of the intensive active surveillance of the quarantine zone at a communal farming. The newly infected farm (third focus of infection) was located within the original 10 kilometer quarantine zone. Spread was thought to be due to contaminated clothing (coveralls). Coveralls from the initially infected farms were found on this site during inspection of the area. Veterinary officials required that the coveralls used during the outbreak were turned in and placed in a pile to be burned as directed by a policy established for destruction of contaminated clothing. However, the DAH concluded that someone removed the coveralls from the pile not following operational procedures established. This issue is discussed in the subsequent section and considered further in the discussion of the risk factors applicable to the RSA.

The DAH decided to redefine the quarantine and surveillance zones, and stamping out was decided to be conducted around the third focus of infection. For this reason, the new quarantine zone was defined with a 15 kilometer radius around the third focus of infection. The previously defined quarantine zone was within the new quarantine zone.

On November 8, four positive serological results were obtained from samples collected during routine surveillance from cattle at a diptank outside of the quarantine zone but within the surveillance zone. The test used was the LPB ELISA, which is a sensitive, rapid and reliable technique for primary diagnosis. No clinical cases were observed that could be linked to the positive serological results. The diptank was located in a communal grazing area that lacked fencing between properties. Veterinary officials decided to stop the culling operation and start a ring vaccination campaign while awaiting the results of samples that were

sent for confirmation to the World Reference Laboratory in Pirbright, United Kingdom. Control measures were extended to include the area where the diptank was located. Therefore, a new quarantine zone was defined and emergency vaccination was initiated in a 15 kilometers around the diptank. This newly defined 15 kilometer quarantine zone was surrounded by a further 20 kilometer surveillance zone in which increased surveillance was planned to be conducted along with movement control enforcement (see Figure 7 for a map illustrating the quarantine and surveillance zones and the focus of infection points).

In the meantime, these samples were tested using virus neutralization tests and 3ABC ELISA. Some of the results of the virus neutralization tests were inconclusive and the results of the 3 ABC ELISA tests were negative. For this reason, on November 11, 180 additional samples were taken from cattle at the diptank and tested with LPB ELISA. The results of these tests were negative; however, for confirmation, the samples were sent to the World Reference Laboratory in Pirbright, United Kingdom. The Laboratory confirmed the results to be negative on November 30 and the DAH concluded that cattle at the diptank were not infected. As a result, the enlarged control area was reduced to the original 30 kilometer radius. Though emergency control measures were subsequently decreased to the original restricted area, it was decided to complete the limited vaccination program in the district of Camperdown. In December 2000, all properties in the 16 districts previously declared as an FMD control area were visited and inspected and random samples taken. Further intensive sero-surveillance data and clinical inspections suggested that the disease did not spread outside the control area that the DAH defined initially.

Control measures in Camperdown District in KwaZulu-Natal Province during and after the outbreak [10, 12, 13, 15, 16, 17, 18]

Once FMD was suspected, the DAH responded quickly initiating an epidemiological investigation. Within 36 hours of FMDV confirmation, the DAH established an emergency management center in a Province outside the area that was identified as the focus of infection, in order to coordinate the response to the outbreak.

Immediately after confirmation, an action plan was drawn and trace backs, culling of infected animals, and orientation to farmers was begun. Logistic support was provided by the SANDF, SAPS, disaster management units and RTI. An average of 17 roadblocks were present throughout the period of the outbreak. A movements control protocol was created and implemented, and a complete ban on the movement of animals, animal products, and agricultural products of the outbreak area was enforced with the roadblocks. All milk from the primary infected area was destroyed during the outbreak. Only milk from the surveillance area was allowed to be moved to registered dairies for pasteurization. An office dedicated exclusively to issue permits, directed by a senior veterinarian, was

established. All animals moved were inspected on the farm before issuing a permit (see Appendix 3 for details of the Movements Control Protocol).

Veterinary personnel were drawn from other provinces to assist with inspections, surveillance and movement controls. A total of 143 veterinary personnel from other provinces were involved in the control operations. Personnel were stationed at all abattoirs in the quarantine and surveillance zones and at other abattoirs in KwaZulu-Natal to control the arrival of animals, inspect all animals pre and post slaughter, and to ensure that the correct documentation was present.

A total of 6,773 animals were culled over the entire period. All farms where animals were culled were sanitized twice by a commercial contractor under official supervision with a 10-14 day interval between disinfections. A total of 367,168 physical inspections were recorded from September 16, 2000 to the end of January 2001 within the quarantine, surveillance zone, and surrounding areas. Premises surrounding the quarantine zone were visited on a 14-day cycle. Game animals from three game reserves bordering the quarantine zone were inspected and serologically surveyed.

As mentioned earlier, on November 8, 2000 veterinary officials decided to stop the culling operation and start a ring vaccination campaign. Over the period between November 2000 to February 2001, 9,738 cattle, 1,219 sheep and 1,457 goats of the Camperdown district were vaccinated with a FMD type O vaccine saponin/alhydrogel. All vaccinated animals were branded with a permanent "F" mark on the left neck or cheek at the time of vaccination. From a period 3 weeks post vaccination up to 6 months later, vaccinated animals were tested using ELISA and 3 ABC ELISA tests. Two cattle farms within the Camperdown district were not vaccinated and left as sentinel herds. No pig farms were vaccinated and these animals also acted as sentinel.

After removal of the movement controls within the province as a whole, the Camperdown district remained under strict movement control for the next two years due to the presence of vaccinated animals. Vaccinated animals were only allowed to leave the Camperdown district if going to an approved abattoir under strict veterinary permit control. In addition, farms with vaccinated animals were inspected at 14-day intervals. All stockowners where required to maintain strict records of all vaccinated animals. The DAH slaughtered all vaccinated animals by the end of 2002.

Prior to restocking, Veterinary Services officials placed sentinel animals (cattle) on the first two infected farms in December 2000. These animals were sampled serologically 30 days later and tested negative. Restocking began on February 2, 2001.

As a result of the FMD spread to other farms within the quarantine zone due to contaminated clothing during the first month of the outbreak, RSA officials

recognized the importance of establishing strict biosecurity measures, and created strategies to be used in the future in case of an outbreak. The DAH created an operational procedure to be used in the case that an outbreak occurs in which coveralls can be inserted in a container and the entire container can be incinerated. The container only allows items to be added but not to be removed. There would also be an assigned person to verify and document that all coveralls are turned in.

As mentioned earlier**, v**eterinary officials traced the source of the outbreak to illegal swill fed to pigs. Investigation results found that the illegal swill was derived from international galley waste from Durban Harbour**.** To mitigate this risk in the future, a protocol on swill management was created and implemented at ports of entry including the Durban Harbour. The main objectives of the protocol are:

- To establish that all ship galley waste, which has the potential to be infectious, must be regarded as quarantine type;
- To terminate the recycling of ship galley waste;
- To establish that ship galley waste can be disposed only of at a registered low hazardous landfill site;
- To establish a system to assign numbered bins to be used for ship galley waste only. These bins must be lined with plastic to contain the waste, and cleaned and sanitized at the disposal site;
- To establish that all ship galley waste must be placed in trenches and disinfected with lime and covered up with soil at registered low hazardous landfill sites only;
- To prevent the spillage during handling and transportation;
- To monitor procedures by risk management personnel on a regular basis and have any deviations rectified immediately.

The protocol also requires precise record keeping from the driver removing the waste to ensure accurate tracking of the bins, disposal of the waste at the hazardous waste site, and washing and sanitizing of the vehicle. Drivers must log the time, harbor area, ship's name, and bin numbers of any bins that are moved. A bin tracking system was established to generate monthly reports. In addition, the Port Operations representative must sign the log sheet when completed.

The site visit team verified the implementation of this system at the Durban Harbour. The most relevant findings of the site visit team were: 1. There is a waste disposal contractor and every 3 years the contract is up for renewal; 2. Containers are marked with a sign stating that they are for ship galley use only; 3. The containers are lined with a bag on the inside to further avoid contaminations; 4. A caretaker visits daily and monitors operational aspects; 5. The operations manager performs an audit every 3 months; 6. Extra bins are chained to posts so they cannot be removed by vagrants; 7. Extra bins were present so that when full, the extra bins could be used; 8. Bins are picked up and taken to the compactor site located on port authority property; 9. After the bins are emptied, they are

washed and sanitized; 10. When the compactor is full, the garbage is taken to a landfill site, which is a hazardous waste dump located west of Durban; 11. Because it is a hazardous waste dump, there is a controlled access with fences into the premises.

Furthermore, the compacting site was fenced off from the remainder of the port and there was a separate fencing within the fenced area that contained the compactor and the waste management employees. The team was told that the gate is always locked if no one is present. Also, the bag is tied when bins are removed and loaded onto the bed of the pickup, and the bin liners are dumped into compactor. The compactor is leach tight to prevent leakage or seeping and it is emptied weekly regardless of the amount of material contained.

The compactor and the bins are cleaned at the landfill with disinfectant. There is an employee always on call every day in case a ship comes into the port after the usual 7:00 a.m. to 3:30 p.m. shift. There is also a system to identify loaded/cleaned trucks using a diamond-shaped sign on the front fender of the truck used to bring bins from the pier. This sign is reversible to show a different color that indicates if the truck is loaded or is empty and sanitized. The trailer also has a plate that states, “Infectious substance” on both sides.

The site visit team noted that someone could remove bins from the area because fencing was not present around the entire pier to prevent unauthorized traffic. In addition, all of the bins were not chained. Plans were in place to enhanced security and build a fence just as there is in the container area explained above. On the containers side of the pier, the bins were more secure at the time of the site visit. The DAH reported to APHIS in recent communications that the area of Durban Harbour where galley waste is received has been completely cordoned off with the erection of fences and gates and the problems found by the site visit team were corrected.

FMD Surveillance in Camperdown District in KwaZulu-Natal Province during and after the outbreak [7, 10, 12, 13, 16, 17]

The Exotic Disease Division of the OVI employs staff to routinely manage between 20,000 and 30,000 serological tests per year. The workload increased to nearly 75,000 tests during the outbreaks. The number of clinical samples submitted and tested for virus isolation and polymerase chain reaction (PCR) also increased dramatically.

During the outbreak, from September 2000 until the end of January 2001, the DAH enhanced FMD surveillance and a total of 367,168 clinical inspections and 34,324 serological examinations were recorded within the quarantine zone, surveillance zone, and surrounding areas. Game animals were also inspected and serologically surveyed on three game reserves bordering the focus of infection area and negative results were obtained.

As a result of the implementation of a limited ring vaccination campaign, the DAH enhanced surveillance in these vaccinated animals. In a period 3 weeks post vaccination up to 6 months later, vaccinated animals showing positive reactions to the LPB ELISA test (used to monitor the serological response to the vaccination) were subjected to the 3 ABC ELISA to monitor the FMDV infection/circulation. All these LPB ELISA positive samples tested negative to the 3 ABC ELISA providing further evidence that no active infection was present. Vaccination ceased in February 2001.

Movement controls within the Province were lifted due to the lack of detection of new cases and the cessation of vaccination. After removal of the movement controls, the DAH conducted inspections every 14 days within the quarantine zone and every 28 days in the surveillance zone. In addition, enhanced surveillance was conducted and the results obtained of the serological testing were negative. Information on the total number of animals inspected (vaccinated and non-vaccinated) and the total number of animals tested serologically (vaccinated and non-vaccinated) after the removal of the control measures is summarized below.

	Cattle	Goats	Sheep	Pigs
Total number of animals inspected	262,271	152,119	42,724	28,473
Total number of animals tested serologically	19,327	444	2,691	3,168

Between February and September 2001, 6,171 animals of the original 12,414 vaccinated animals (50%) were sampled. Only 45 animals tested positive for antibodies to serotype O (0.7% of the animals tested). During November and December 2001, an additional 1,543 animals were tested with no positive results. By the end of December 2001, 99% of the vaccinated animals tested had lost their titers which was used by the DAH as an indicator that no active infection was present or circulating. Sero-surveillance of vaccinated animals decreased in 2002 and by the end of the year the last few vaccinated animals that remained alive were slaughtered, eliminating the risk of the possibility of animals masking clinical signs due to vaccination that were not detected by sero-surveillance.

In addition, the DAH conducted a serological survey from December 2001 to January 2002, to provide evidence of FMD-freedom in the export zone in a formal request to the OIE. The sampling units were then identified according to low and high risk areas. High risk was defined as areas where, if there was an FMD outbreak, it would be able to spread quickly through the cattle population. The areas of low and high risk were defined with inputs from National and Provincial-level veterinarians. The criteria used to define low and high risk were based on: 1. Proximity of areas to the area of the previous FMD outbreak, 2. Proximity to the

FMD-controlled areas, 3. Areas of high cattle density, 4. Communal areas where cattle from a high risk area could have been transported to.

As a result of this survey, a total number of 15,089 animals were tested. Positive results were observed using the LPB ELISA, but proved to be false positives using serum neutralization tests.

Additional serological surveys were conducted in the export zone to monitor FMDV as a result of an outbreak in Mpumalanga Province, and are explained in more detail in the discussion of the mentioned outbreak.

Conclusion of the discussion of the outbreak in Camperdown District in KwaZulu-Natal Province

Prior to the outbreak in 2000, the last FMD outbreak in the export zone of the RSA occurred in 1957. This represents a significant amount of time, and the lack of experience recognizing FMD clinical signs in susceptible animals is considered to be a significant factor contributing to the initial delay of FMD suspicion during the initial investigation of this outbreak (this issue is considered further in the section that discusses the risk factors applicable to the RSA). However, vesicular lesions were detected in other animals within a week of the initial investigation and a quick response was initiated immediately establishing a FMD control center outside the focus of infection, and creating a Joint Operational Committee to assist in control measures. It is considered that the planning and implementation of the emergency response was rapid and adequate. The establishment of quarantine and surveillance zones was well planned and adequately implemented. In addition, the creation of a movements control protocol was rapid, and its implementation was effective containing the disease to the quarantine zone. Furthermore, the DAH proved to be capable of moving personnel from other Provinces to assist in control measures during the outbreak.

Within the quarantine zone, FMD spread to other farms due to the lack of adequate biosecurity measures (this issue is considered further in the section that discusses the risk factors applicable to the RSA). However, the DAH was able to quickly detect these farms due to an effective active surveillance. In addition, the DAH controlled further spread of the disease, and created SOP's to mitigate this risk in the case of future outbreaks.

The DAH responded quickly to the identification of positive ELISA tests results of samples taken in the surveillance zone surrounding the quarantine zone, and decided to enlarge the quarantine and surveillance zones while waiting for results of follow up supplementary tests. These positive ELISA results were confirmed to be false positives; however, DAH's decision of enlarging the quarantine and surveillance zones as a result of these false positives is considered to be an adequate emergency response to prevent FMDV spread.

DAH's decision to stop the culling operation and to commence a ring vaccination campaign demonstrates that the DAH has an adequate authority and infrastructure that is able to identify and quickly respond to emergencies. In addition, it appears that the emergency vaccination campaign and the surveillance of vaccinated animals were effective controlling the further spread of the disease. Furthermore, it is considered that the use of sentinel herds was a suitable practice to monitor virus circulation. Further surveillance of sentinel herds provided additional serological evidence that FMDV was not circulating in the area.

The DAH maintained adequate movement controls for two years due to the presence of vaccinated animals in the Camperdown district and all vaccinated animals were slaughter by the end of 2002. Restocking procedures after depopulation was completed and the further surveillance of these animals were adequate. It is considered that the DAH provided sufficient surveillance data to demonstrate that FMD was eradicated from this area.

Furthermore the DAH performed tracing investigations and was able to determine the cause of the FMD outbreak. As a result of the determination of international galley waste as the cause of the outbreak, a protocol to mitigate this risk in the future was created (this issue is considered further in the section that discusses the risk factors applicable to the RSA). The creation of this protocol and the procedures it defines appear to be adequate measures to mitigate the risk of FMD introduction into the RSA from international galley waste. The site visit team verified the implementation of this system at the Durban Harbour and appeared to be practical and well implemented with the exception of security breaches observed by the team. However, the DAH informed APHIS in recent communications that these problems were corrected.

Middelburg District in Mpumalanga Province

Synopsis of the Outbreak in Middelburg District in Mpumalanga Province [7, 16]

Mpumalanga has a common border with Mozambique running roughly due north from the Swaziland-Mozambique border along the watershed of the Lebombo Mountains. The Komatipoort district has the southern section of this boundary; the rest is the eastern boundary of the KNP. Some of the districts of Mpumalanga are located in the buffer zone of the RSA that separates the remainder of the country from the KNP. Middelburg is a halfway and isolated town between Pretoria and Lydenburg and is not part of the buffer zone of the RSA (see Figure 8 for a map of the Mpumalanga Province).

On November 24, 2000, vesicular lesions were observed in cattle originating from a feedlot in Middelburg at a slaughter plant in Swaziland. Officials of that country collected samples and submitted them to OVI (November 28, 2000),

which confirmed SAT 1 in November 29, 2000. The Director of Veterinary Services in Mpumalanga was notified of the positive diagnosis, as was the National Director of Veterinary Services and an investigation was immediately conducted in the cattle's farm of origin. The farm was placed under quarantine and all movements were stopped. Inspection of animals was conducted and clinical lesions were detected in 30 cattle. Samples were immediately taken and dispatched to the OVI and confirmed positive for FMDV SAT 1 the same day. Subsequent samples submitted on November 30, 2000 also yielded positive results for FMDV SAT 1.

Within 24 hours of the initial confirmation, a Joint Operational Committee was established. A quarantine zone was defined in a radius of 10 km around the index farm and a surveillance zone in a radius of 25 km around the index farm. Quarantines, inspections, and trace backs were initiated immediately. All movements of livestock out of the quarantine zone were prohibited.

Cattle in the feedlot were sourced from Namibia, Mpumalanga Province, Nkomazi, Free State Province, and Eastern Cape Province. The feedlot employed two agents who purchased animals from other farmers. The feedlot also fed animals of outside customers, which is called contract or custom feeding. These animals were sourced from different farmers and from any area of the country owned by private individuals who are butchers and retailers in the meat trade.

Results of the investigation showed that cattle were purchased in Nkomazi (Nkomazi borders the KNP and is part of the Buffer zone) and transported directly to the feedlot without inspection or permits as required by law. The DAH determined that a veterinarian with a financial interest issued the movement permit for the cattle from Nkomazi that was introduced into the feedlot. The epidemiological investigation revealed that the virus found was related to viruses previously isolated from buffalo in the south of the KNP. DAH concluded that the cattle became infected due to buffalo/cattle contact in the Buffer zone of Nkomazi, after a flood severely damaged the fence separating the KNP (see Figure 2 for a map illustrating the results of the tracing investigation).

Additional farms and communal dip tanks were investigated within the Nkomazi area as discussed in the *FMD Outbreaks in the Buffer Zone with Vaccination* section**.**

The infected feedlot maintained cattle, sheep, and pigs. The cattle and sheep were housed in separate fenced facilities that were located approximately 300 meters from the pig holding facility. There was no immediate physical or human contact between the two units. Strict biosecurity was used to prevent cross contamination between the feedlot and the pig facility with disinfection of all personnel and vehicles entering and leaving the infected area. No clinical signs or serological evidence of FMD were observed in the pig facility.

At the feedlot, the animals that exhibited clinical signs were located in the southern portion of the feedlot that was allocated to custom or contract feeders. As stated previously, these animals were determined to be the source of infection. Eventually, a small number of cattle in the middle of the feedlot exhibited signs and all animals that showed clinical signs were moved to the southern section of the feedlot. A section between the clinically affected and the rest of the animals was left empty. Dedicated personnel performed duties in the two sections. The pens were disinfected with lime and a fence was erected with one entrance gate.

The disease was contained to the feedlot and the DAH prevented spread of the FMDV to other areas using strict control measures and vaccination of all cattle in the feedlot. On January 15, 2001, the slaughter of vaccinated sheep and cattle was begun and completed on March 19, 2001. No additional clinical cases have been observed in the feedlot since the last case reported on December 14, 2000.

Control measures in Middelburg District in Mpumalanga Province during and after the outbreak [7, 10, 16, 17]

Upon confirmation of FMD, veterinary officials issued movement restriction notices to the feedlot and owners of premises within the10 km-quarantine zone. In addition, a sanitary cordon was established to control the movement of animals and animal products and a serological surveillance and daily physical inspections were carried out in the index farm. Quarantine notices were issued on all surrounding farms (28) with inspection of all livestock and serological surveillance performed. For instance, one farm within the quarantine zone had 2,200 cattle, 12,000 pigs, and 200 sheep that were inspected daily and serum samples were frequently taken for surveillance.

Four roadblocks were established to monitor movements out of and through the quarantine area. SAPS, SAND, and RTI officials assisted in movement controls. In addition, two road blocks were established on gravel roads at the main entrance to the feedlot and to the piggery.

The abattoir that was located on the premises was closed during the disease control period. Carcasses that were already in the abattoir were deboned, and the meat consumed on the estate. Pig carcasses, skins, offal, bones, and other materials were disposed of by incineration on the premises under official supervision.

All trucks entering and exiting the premises were disinfected. The commercial leasing of trucks was no longer allowed. Movement of manure from the feedlot was stopped. Prior to the outbreak, livestock feed was produced on the premises. As a result of the outbreak, the distribution of dairy meal and pig feed was stopped. However, under strict control and security, only chicken feed was marketed. There was strict control of people as to movement and disinfection to

prevent spread of the disease. There was also 24-hours security to ensure that no unauthorized people or vehicles entered the pig premises.

The movements out of the infected farm were strictly restricted. After vaccination and the clinical endpoint of disease in the feedlot, commercial swine were clinically inspected and loaded onto sealed limed vehicles and transported to slaughter at dedicated abattoirs on specific days under strict veterinary control.

Veterinary officials accompanied the vehicles to the abattoir, which was disinfected thoroughly after the slaughter of each consignment. The pH of carcasses was monitored to ensure that the level was below 6 within 24 hours, and all carcasses were deboned, as recommended by OIE guidelines. A further 3-week waiting period was enforced for the meat pending serological results of samples collected on the slaughter line and on the farm. Bones and offal were destroyed under strict control. Meat was released for local consumption only.

The movements out of the quarantine zone (excluding the infected farm) were slightly different and less restrictive than those of the index farm. After vaccination and the clinical endpoint of disease in the feedlot, the slaughter of pigs from two large farms in the quarantine zone was closely monitored by DAH officials. All animals of the quarantine zone had to be inspected and bled prior to movement, the pH of carcasses had to drop below 6 within 24 hours, heads and feet had to be destroyed, and the meat had to be used locally. All meat from the quarantine zone was held for 8 days to ensure that inspections and sero-surveillance samples from the farm of its origin and the index farm were negative.

At the end of March 2001, veterinary officials removed movement restrictions from the quarantine zone, with the exception of the feedlot (index farm). At the same time, disinfection of the entire feedlot was begun. After disinfection, 200 sentinel cattle were introduced. These animals were bled before placement onto the feedlot and 14 days later. They were inspected twice a week. On May 2, 2001, quarantine was lifted in the feedlot and the pig facility.

In addition, due to the outbreak, the Feedlot Association decided to no longer purchase mixed source animals from consignment buyers or auctions and to restrict purchase to known producers in the export zone of the RSA. There is a total prohibition of animals from a FMD-controlled area (i.e. the buffer zone and the KNP) at any feedlot in the export zone.

Also, any veterinarian who has financial interest cannot certify or conduct tests on his or her own animals based on a rule of the Veterinary Council. This rule was in place prior to the outbreak, and it was not followed properly. As mentioned earlier, one of the owners of the feedlot was a veterinarian and was doing regulatory work for his own feedlot creating a conflict of interest (this issue is considered further in the section that discusses the risk factors applicable to the RSA). DAH officials stated that this was an isolated case and measures were

taken after the outbreak in order to prevent future infractions like this. Such measures include the implementation of a temporary suspension of the certifying official veterinarian from their duties until the investigation is over and / or the notification of the ethical committee of the South African Veterinary Council, depending on the outcome of the investigation. In addition, a National Auditing Program has been established that includes auditing of certification procedures and level of knowledge of the certifying officials. This Program is also auditing all export establishments giving special attention to the certification process of the veterinary officials, and providing training to newly appointed officials.

In addition, the RSA amended the FMD regulations so that movements of unvaccinated livestock from the buffer zone into the export zone will be preceded by clinical inspection, in addition to the established quarantine and serology requirements prior to the movement. This measure provides an additional opportunity for the State veterinarian of the final destination to detect any abnormalities in the process. Also, vaccinated animals will only be permitted out of the buffer zone for direct slaughter and with an authorization of the PD or the PEO. Moreover, the DAH created a livestock identification system to facilitate traceability of animals moved.

Vaccination and Slaughter in Middelburg District in Mpumalanga Province

Stamping out was not conducted because veterinary officials believed that destroying the animals posed a large risk of virus dissemination. There were a large number of animals on the premises: 48,376 pigs, 14,308 cattle, and 2,445 sheep. In addition, the feedlot's strict control measures and secure infrastructure met those of a quarantine facility. Veterinary officials performed emergency vaccination to minimize virus excretion within the cattle feedlot and to prevent FMD from spreading to the piggery. This was considered to present the least risk of the piggery becoming infected.

On December 8 and 9, 2000, pigs (over 48,000) were vaccinated once with a SAT 1 vaccine. All vaccinated commercial swine, with the exception of vaccinated culled sows, were slaughtered by July 31, 2001. The piggery remained uninfected as indicated by serological tests using LPB ELISA tests prior to vaccination and 3ABC ELISA tests in addition to LPB ELISA post-vaccination. In fact, 92 percent of vaccinated culled sows were seronegative when tested in early 2002. Vaccinated breeding sows were slaughtered over the course of 4 years, with the last animal slaughtered in March 2004. Prior to slaughter of all vaccinated pigs, including breeders, veterinary officials prohibited the movement of these pigs from the farm except for direct slaughter. Meat and meat products derived from slaughtered pigs were consumed locally. These were not allowed to be slaughtered at export slaughter facilities.

The sheep were vaccinated once with the trivalent vaccine on December 4, 2000. All cattle in the feedlot were vaccinated twice with a trivalent (SAT 1, 2, and 3)

vaccine on December 1 and 18, 2000. The commercial breeding cattle (1,200 heads) were vaccinated while on grazing pastures on December 4, 2000. After the second vaccination, they were moved to the northern section of the feedlot placing them furthest from where the FMD outbreak was detected. By moving the commercial breeding cattle, a 5-kilometer animal-free zone was created around the infected premises.

On January 15, 2001, slaughter of feedlot cattle and sheep for local consumption began under strict control at selected quarantine abattoirs under veterinary supervision. The vaccinated cattle were tested using a 3ABC ELISA test. Results of the test were used to determine whether the pens were previously infected or not. Infected pens were subjected to dedicated slaughter sessions. The meat was deboned and heads, feet, bones, and offal were incinerated, buried, or cycled through by-product facilities. All vaccinated feedlot cattle that was determined to be infected and sheep were slaughtered by March 19, 2001. All calves born to these cattle were also slaughtered.

By the end of March 2001, the vaccinated commercial cattle that were not infected were released to grazing and kept away from the feedlot and the piggery. The cattle were inspected once a week and bled monthly. All vaccinated commercial cattle (non-previously infected) were slaughtered by December 5, 2001. The meat was deboned and marketed for local consumption only. Calves were also slaughtered by December 5, 2001 as well. By the end of March, disinfection of the feedlot was completed. Sentinel cattle (200) were introduced in April 2001. The sentinels were bled prior to entry and 14 and 28 days after entry. All results were negative. In addition, the sentinels were inspected twice a week.

Quarantine was lifted on May 2, 2001, for the feedlot and the pig facility. Reintroduction of animals began soon after.

Marketing restrictions remained in force for vaccinated sows and boars in the quarantine area and the focus of infection, and these animals could not be slaughtered at export abattoirs. Meat and meat products derived from slaughtered pigs were consumed locally.

FMD Surveillance in Middelburg District in Mpumalanga Province during and after the outbreak. [7, 12, 13, 16, 17]

Veterinary officials conducted inspections in the infected feedlot and piggery twice a day and serosurveillance once a week. In the quarantine zone, inspections were performed twice a week and once a week in the surveillance zone. Veterinary officials performed these inspections until January 12, 2001.

From January 15 to 31, 2001, veterinary officials conducted inspections once a day in the feedlot and piggery of the infected premises and once a week in the

quarantine zone. They also performed serological surveillance once a week on cattle from the feedlot that were to be slaughtered and the piggery.

From February 1 to March 19, 2001, veterinary officials conducted inspections in the feedlot three times a week. They also performed serological surveillance in cattle before animals were to be moved for controlled slaughter[12], and serological surveillance was done in the piggery every 2 weeks. In the quarantine zone, veterinary officials conducted inspections every second week and serological surveillance once a month until the end of April 2001.

From March 19 to 31, 2001, veterinary officials conducted inspections in the piggery three times a week and serological surveillance every 2 weeks.

From April 1 until the end of July 2001, veterinary officials conducted inspections at the piggery once a month.

By the end of July 2001, veterinary officials had inspected 1,708,943 cattle; 128,163 sheep; and 3,570,363 pigs. Additional veterinary officials and AHTs from other provinces had to be deployed to the outbreak area to assist in control and surveillance activities during the outbreak. Information regarding the surveillance activities from November 29, 2000, to July 31, 2001 is summarized below.

	CATTLE	SHEEP	PIGS	GOATS
Census	69,052	11,769	74 025	653
No. of Inspections Performed	1,709,441	128,170	3,570,397	1,020
No. of Rounds of Inspections	113	43	132	13
No. of Animals Mouthed	25,141	498	564	18
No. of Serum Samples Submitted	5,228	1,475	2,125	136
No. of Vesicular Samples Submitted	2	0	1	0
No. of Tissue Samples Submitted	24	1	4	0
No. of Visits to Property	975			
No. of Herds	196			
No. of Farms	130			

In addition, the DAH conducted a serological survey in 2002/2003 in the high risk areas identified during the survey conducted in 2001 as a result of the KwaZulu-Natal outbreak. The criteria used to define low and high risk are those that were previously explained in the surveillance section of the KwaZulu-Natal Province outbreak. A total of 9,917 samples were tested at the OVI. All positive results were confirmed to be false positive with further clinical and serological investigation using 3 ABC ELISA.

[12] Controlled slaughter- The movement of animals under a red cross permit from the farm of origin to a designated abattoir under strict movement restrictions.

Conclusion of the discussion of the outbreak in Middelburg District in Mpumalanga Province

Once samples were sent to the OVI, diagnosis of FMDV was carried out and appropriate authorities were informed quickly. It is considered that the planning and implementation of the emergency response was quick and adequate. The establishment of quarantine and surveillance zones, and the creation and implementation of a movements control protocol were effective measures containing the disease in the index farm. In addition, biosecurity measures taken in the index farm were well planned and effective.

The emergency vaccination campaign and the surveillance of vaccinated animals were effective in controlling and monitoring the spread of the disease, respectively. Movement controls and slaughter of vaccinated animals were strictly monitored and appears were efficient. In addition, it is considered that biosecurity and movement controls enforced in meat and products of vaccinated animals were adequate.

Quarantine was lifted in May 2001 after the slaughter of all vaccinated animals with the exemption of vaccinated sows; however, the DAH maintained adequate movement controls due to the presence of these animals. The placement of sentinel animals during this period, and the further surveillance of these animals, were effective measures providing evidence that FMDV was not circulating in the feedlot. All vaccinated sows were slaughtered by March 2004.

Furthermore the DAH performed tracing investigations and was able to determine the source of the FMD outbreak. As a result of the determination of illegal movements of animals as the source of the outbreak, the DAH and the industry implemented measures to prevent this risk in the future. The communication and implementation of these measures created awareness of the consequences of illegal movements amongst certifying officials, and compliance with these procedures are monitored by the National Auditing Program. These measures are considered sufficient to discourage certifying officials from allowing or conducting illegal movements of animals. Furthermore, the creation of a livestock identification system facilitates the traceability of animals moved.

Additional control measures taken in the entire country after the outbreaks [7, 10, 13, 15, 17, 18, 19, 20]

Identification of animals and farms

The RSA Animal Identification Act of 2002 was published on November 21, 2003, and its implementation commenced at the end of March 2005. This Act makes provision for three levels of identification of animals, and provides for marks to be unique and

specifically registered to the owner of the animals who applies to the registrar of the Animal Identification Act.

Owners of cattle, sheep, and goats must identify their animals. This system provides for permanent one to three character marks that link the animal to the owner. For instance, even an owner of only one or two cattle must have identification. The system operates from a central database and can link animals with the farm of origin as well as the current owner. It is important to note that the system does not identify individual animals. Every owner must have a brand and cattle must be marked by 6 months of age. The marking system makes provisions for hot or cold iron branding for cattle, and tattooing for small ruminants, and pigs. This compulsory identification adds further control to prevent illegal animal movement.

An action plan for awareness of the further implementation of branding of the identification marks into animals was implemented early in 2004 in the FMD-controlled areas (i.e. the buffer zones). However the application of branding was initiated at the end of March 2005 and was not completed to a 100% as of January 2007. The implementation of the Animal Identification Act of 2002 is being evaluated. The application of branding is extensive and the DAH contemplates it will take several years to complete.

The DAH considers that it would be difficult to implement individual animal identification outside of the FMD-controlled areas. Therefore, the DAH decided to prioritize identification of livestock for export purposes. For this reason, the DAH created Veterinary Procedural Notices (VPNs) for sheep export farms and beef export farms. These notices define provisions for individual identification and traceability of animals and their products destined for export. The VPNs includes the rules on certification, especially those stipulated in the European Union Council Directive 96/93/EC and the OIE, and have been provided to all provincial veterinarians.

In addition, the Directorate of Agricultural Statistics is developing a farm registration system named The National Farmer Register (NFR) and it will be implemented once is completed. The NFR will be a database that will contain information such as the name of the owner of the farm, the location of the farm, and will describe the purpose of the farm. This system, if created and implemented adequately, will complement efforts of the DAH for identification of farms.

Training

The DAH initiated an intensive training program of all provincial veterinarians that are allowed to issue certificates. This program was initiated to improve the training of official veterinarians in meat producing establishments, and to address deficiencies found in the certification procedure (e.g.. certification of statements to allow the movement of animals that were not true as in the case of the cause of the outbreak in Mpumalanga Province) by the European Commission in the Food and Veterinary Office's report of the outbreaks. The DAH began training veterinarians in one Province at a time on June 28, 2004, and

training was completed in all Provinces with the exception of the Eastern Cape. Training in this province was not completed due to the fact that priority was given to an emergency response to classical swine fever outbreaks that occurred at that time. The training sessions covered the rules of certification. The DAH plans for the training to be on-going, especially with the appointment of new veterinarians. The training address export certification procedures of skins, live animals, meat establishments, amongst other issues. Also, a National Auditing Program has been established that includes audit of certification procedures and level of knowledge of the certifying officials.

International Movements controls

The RSA also provided information regarding confiscation of animals and animal products at international ports and border posts. Live animals and commodities that arrive at the border post without the proper import documentation are refused entry and returned to the country of origin. In the RSA, the most critical ports of entry are the Beit Bridge border post at Zimbabwe, the Lebombo border post at Mozambique, and the International Airport in Johannesburg. For 2002, 2003, and 2004, the confiscated commodities included meat products, milk products, dogs, goats, and sheep (see Appendix 5 for details of the amounts of confiscated commodities). At the Johannesburg International Airport, no records were kept of confiscated and destroyed products. However, in December 2004 the RSA introduced the use of dogs specially trained to detect food and food products, and started to maintain records of all confiscated materials and products.

Other measures taken as the result of the outbreaks in the export zone in 2000

The FMD outbreaks in the export zone triggered the implementation of several initiatives as control measures against FMD such as:

- Gathering of FMD information (in pamphlets) and distributing it to the industry, the private veterinary practitioners, and the general public,
- Using such information for several newspaper articles at the regional and State Veterinary Area level, and for two radio transmission (30 min. each) at several communities affected by the outbreaks,
- Increasing the number of extension meetings with commercial and communal farmers, auctioneers and abattoirs in each region,
- Scheduling high level meetings at the Department of Agriculture with major stakeholders to discuss various aspects of FMD, risk of disease spread, and preparedness of Veterinary Services,
- Updating each Region's contingency planning,
- Sending Veterinary Services field personnel from throughout the country to outbreak regions in order to assist field personnel with FMD control, and to acquire experience handling a FMD emergency,
- Establishing a 24- hour telephone service at the Province offices of the Directorate Veterinary Services, to respond to possible reports of suspected cases of FMD,

- Developing a program of intensified surveillance by means of visits and inspections of livestock production premises (auction places and abattoirs) and clinical examinations of their animals, mainly in the areas that were considered high risk,
- Conducting serological surveillance (during the above-mentioned program) targeting animals thought to be at possible high risk.

Conclusion of additional measures taken in the RSA after the outbreaks in the export zone in 2000

Individual animal identification in the whole country is considered to be difficult to implement; however, the RSA published and implemented the Animal Identification Act of 2002 to link animals to an owner. This system is supported by the creation of VPN's created defining provisions for identification and traceability of animals and animal products for export. The creation and implementation of these compulsory identification systems appear to be functional and effective linking animals to an owner and allow rapid traceability of animals.

The DAH recognized as a result of the outbreaks, the need of creating a training program for veterinarians that are allowed to issue movement certificates. It is considered that the creation and implementation of this program enhanced the capacity of officials issuing movements certifications, and created awareness of the implications and consequences of illegal movements certifications.

Information submitted by the DAH provides evidence that the inspections of commodities, passengers, and baggage carried out at international ports of entry are well documented and are sufficient in reducing the risk of introduction of FMD through these ports.

Overall, initiatives implemented by the DAH during and after the outbreaks, the involvement of the central and provincial government, and public extension to the community and farmers are satisfactory.

Risk factors applicable to the RSA

This section summarizes the risk factors and certain mitigations identified for the RSA regarding policies and infrastructure existing for emergency response to outbreak situations.

1. *FMD is endemic in the KNP*

African buffalo are carriers and the principal reservoir of FMD South African types (SAT) 1, 2, and 3 and the RSA and the OIE considers FMD to be endemic in the African buffalo population of the KNP. For this reason, the RSA has

identified three zones within its territory that have a distinct health status with respect to FMD for the purpose of disease control and/or international trade.

The KNP is separated from the remainder of the country by a game-proof fence. Strict control measures are applied to prevent the spread of the FMDV to the export zone of the RSA. In addition, a buffer zone is defined and consistent with guidance outlined in Chapter 1.3.5 of the OIE Terrestrial Animal Health Code along the border of the KNP to prevent spread of FMD into the export zone. APHIS considered these mitigations satisfactory after conducting an evaluation of the 11 factors defined in title 9, *Code of Federal Regulations*, section 92.2, and on April 17, 2000, recognized the export zone of the RSA as free of FMD.

2. *Destruction and damages of the fence bordering the KNP causing outbreaks in the buffer zone*

The veterinary fence along the western and southern boundary of the KNP was erected in the 1960's to prevent contact between African buffalo and cattle in adjacent farming areas to mitigate the risk of FMD and other disease outbreaks in cattle. Veterinary services personnel are based along the fence and do continuous patrols of the fence on foot, bicycle, and/or donkey. Each person has a specific 10 to 15 kilometer section of the fence for which he or she is responsible. Fence patrol teams also identify damaged areas of the fence and make repairs. If buffalo escape from the KNP because of damages of the fence, they are reported to veterinary officials by the fence patrol teams, or by village herd owners who site and report the animals. The animals are located as quickly as possible and herded back into the park by helicopter or shot, if necessary, to prevent contact with livestock of the buffer zone.

Due to aging of the structure, in 1998, upgrading of the 2.4 meter high electric perimeter fence began. In Mpumalanga, progress on the fence was about 70 percent complete when, on February 7, 2000, a flood occurred that interrupted the fence upgrade activities and damaged a significant part of the fence along the southern boundary of the KNP. This allowed 620 buffalo to move out of KNP into the adjacent Nkomazi area and allowed contact between buffalo and cattle to occur, despite efforts employed to chase back herds of buffalo using helicopters. This was an inordinate number of buffalo compared to previous years in which 4 to less than 40 buffalo per year crossed the fence. The entire area became water logged and posts could not be set to repair the fence.

Replacement of the flood damaged sections of the veterinary fence along the southern boundary of KNP was initiated and by February 2003, an electrified fence of approximately 350 kilometer long and 7.87 feet tall along the southern and southwestern borders of KNP was completed. The erection of this fence is a significant and effective barrier to avoid contact between buffalo in the KNP and cattle in the buffer zone.

Flood damage to the veterinary fences located at the boundaries of the KNP can only be prevented by placing the fence higher than the standard height. However, placing the fence higher than the standard height will infringe on cultivated lands and orchards. Therefore, damage to the veterinary fence by flood or as consequence of any other natural hazard is possible to occur. Such damages to the fence may result in infected buffalo to move out of the KNP, and to become in contact with cattle of the buffer zone with vaccination. Although there have been occasional outbreaks in the buffer zone due to buffalo/cattle contact, the DAH has been able to control the outbreaks and mitigate the risk of introduction of the FMDV into the export zone proving the capability to apply effective control measures.

3. *Illegal movement of animals for contract feeding and conflict of interest issues*

The outbreak confirmed in the Middelburg District in November 29, 2000 was due to an action that was not in compliance with the FMD regulations; a serological test for FMD was not conducted prior to the removal of an animal from the buffer zone. The DAH determined that a veterinarian with a financial interest issued the movement permit for the cattle from Nkomazi that was introduced into the feedlot in Middelburg. As mentioned in the discussion of this outbreak, the DAH determined that buffalo/cattle contact was the most likely cause of the initial infection in the cattle from Nkomazi.

The response to this outbreak was rapid after diagnosis, and susceptible animals were identified and quarantine was established before spread of the FMD.

In addition, due to the outbreak, the Feedlot Association decided to no longer purchase mixed source animals from consignment buyers or auctions and to restrict purchase to known producers in the export zone of the RSA. Therefore, if a feedlot custom feeds, the animals must belong to farms with an inspection record and there is a total prohibition of animals from a FMD-controlled area (i.e. the buffer zone and the KNP) at any feedlot in the export zone.

Also, any veterinarian who has financial interest cannot certify or conduct tests on his or her own animals based on a rule of the Veterinary Council. This rule was in place prior to the outbreak, and it was not followed properly. DAH officials stated that this was an isolated case and the following measures were taken after the outbreak in order to prevent future infractions:

- The implementation of a temporary suspension of certifying official veterinarians suspected of illegal activities from their duties until the investigation is over. In addition, the ethical committee of the South African Veterinary Council would be notified and further measures would be taken, depending on the outcome of the investigation.
- The creation of a National Auditing Program that audits certification procedures and the knowledge of the certifying officials. This Program is also

auditing all export establishments and is providing training to newly appointed officials.

- The amendment of the FMD regulations so that movements of unvaccinated livestock from the buffer zone into the export zone will be preceded by clinical inspection at arrival performed by the State veterinarian at the final destination. This new requirement is considered a further mitigation measure in addition to the established quarantine and serology requirements prior to the movement. In addition, vaccinated animals are only permitted out of the buffer zone for direct slaughter and after approval of the PD or the PEO.
- The creation of a livestock identification system to facilitate traceability of animals moved.

The implementation of these measures created awareness amongst certifying officials and compliance with these procedures are monitored by the National Auditing Program reducing the risk of conflict of interest issues and illegal movement certifications. In addition, the requirement of a clinical inspection at arrival of unvaccinated animals moved from the buffer zone into the export zone provides an additional opportunity for the State veterinarian of the final destination to detect any abnormalities in the process. APHIS considers these measures to be adequate and anticipates that they will discourage illegal activities.
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4. *Lack of enforcement of regulations prohibiting swill feeding of international waste*

The outbreak in Camperdown began because of feeding of swill to pigs derived from galley waste. However, the feeding of international waste is prohibited, and it is illegal to feed swill of international origin. Although this regulation was in place, swill feeding of international waste was the cause of the outbreak.

Procedures were established to prevent the future diversion of galley waste to premises that maintain livestock. The DAH issued official orders as control measures to all Port Authorities to not allow any possible contaminated material, including galley waste, to leave the premises unless it occurs under DAH official's control. This official order served as a reminder to Port Authorities of the regulations and procedures regarding galley waste. It also reinforced compliance with these regulations via supervision of DAH officials. As a result of this experience, now Port Authorities must ensure that the swill is destroyed under DAH's supervision.

In addition, the Regional Director of the Department of Water Affairs and Forestry in Kwazulu-Natal issued a directive in cooperation with the Department of Agriculture and Land Affairs Minister, reclassifying galley waste to low hazardous waste. In fact, the Department of Water Affairs and Forestry now requires that all galley waste from ships in the Port of Durban must be regarded as quarantine type waste that has a potential to be infectious and as such, must only be disposed of at a low hazardous landfill site. In addition, the waste must be

disinfected and pretreated with lime before disposal into the trenches at the landfill site.

Furthermore, a protocol on swill management to prevent the diversion of galley waste was created as a result of the outbreaks, and implemented at ports of entry including the Durban Harbour. The site visit team evaluated the efficacy of this system at the Durban Harbour and noted that bins from the area where galley waste is received could be easily removed or waste could be extracted by civilians because fencing was not present around the entire pier to prevent unauthorized traffic. In addition, all of the bins were not chained. However, the DAH indicated that the area of the Durban Harbor where galley waste is received has been completely cordoned off with the erection of fences and gates and the problems found by the site visit team were corrected.

There are 52 ports of entry in the RSA but waste disposal is done as described earlier only at 9 of these ports (only at harbor and international airports). The remaining 43 are land border ports of entry. At all other ports of entry, galley waste or other risk material is to be destroyed by incineration or the use of burning tires.

In conclusion, measures taken by the DAH and the Department of Water Affairs and Forestry, and the implementation of the protocol on swill management at ports of entry are considered adequate and efficient reducing the risk of swill feeding of waste of international origin.

5. *Lack of experience detecting FMD*

Previous to the Camperdown District outbreak, FMD had not been seen in the export zone of the RSA since 1957 and the possibility of an FMD infected animal was not considered when clinical signs were first observed during the outbreak of 2000. However, it is now considered that the awareness of FMD and its symptoms after the occurrence of the outbreaks has significantly increased. It was estimated that the outbreaks in 2000 provided first-hand experience to over 800 veterinarians and AHTs in the response and handling of FMD outbreaks. Furthermore, regardless the increased awareness of FMD after the outbreaks, the DAH has trained veterinary personnel in the diagnosis and management of the disease. Due to increased recognition and experience, FMD is likely to be detected if it was to occur and it is contemplated that FMD will be considered as a rule out in the future.

6. *Lack of biosecurity procedures addressing human movements and contaminated clothing*

Human movement was suspected as the most likely cause of the spread of FMD within the Camperdown District during the outbreak in 2000. As mentioned in the discussion of the outbreak, coveralls used by personnel handling the

emergency in the primary focus of infection were found at the farm where the FMD was spread. As a result of the outbreaks, RSA officials acquired experience and recognized the importance of movement controls, and created strategies to be used in the future in the case of an outbreak. In addition to the increased awareness after the outbreaks, veterinary officials plan to use in the case that an outbreak occurs, a container in which the coveralls can be inserted and the entire container can be incinerated. The container would be one in which items can be added but not removed. There would also be an assigned person to verify and document that all coveralls are turned in.

The implementation of these procedures would further reduce the likelihood that movement of personnel while performing control activities would cause spread of the FMDV due to contaminated clothing. It is considered that DAH personnel will implement adequate biosecurity procedures to mitigate the risk of FMD transmission.

Release Assessment Summary

This section discusses the risk factors associated with the importation of ruminants, ruminant meat, and other meat products of ruminants from the RSA in the context of appropriate risk mitigations applied to reduce the risk of introducing FMD in the U.S.

1. *FMD in the KNP*

   FMD is endemic in the KNP and stamping out is not practical or feasible because African buffalo are the principal reservoir of FMD. Consequently, there is an ongoing risk of reintroduction of FMDV from the KNP into the export zone. However, the establishment of a buffer zone with strict movement controls mitigates the risk of FMDV introduction into the export zone of the RSA. APHIS considers these mitigations satisfactory.

   Conclusion: Any animals or animal products exported to the U.S. if trade with the RSA is reinstated, will originate only from the export zone which is the area of the RSA that excludes the buffer zone and the KNP. FMD-susceptible animals and products from the buffer zone or the KNP would continue to be prohibited.

2. *Outbreaks in the buffer zone due to cattle/buffalo contact from the KNP after destruction of the fence bordering the KNP*

   In 2000, integrity of the fence was breached, and buffalo escaped the KNP and moved into the buffer zone. Reconstruction and improvements of the fence were completed in 2003. In addition, Veterinary services personnel monitors and make repairs to damaged areas of the fence.

Furthermore, the buffer zone acts as a neutral territory to safeguard the remainder of the RSA from FMDV infected areas such as the KNP. During the outbreaks in this zone, which were due to contact of cattle with buffalo from the KNP, the DAH used emergency vaccination, movement controls, and enhanced surveillance to control and eradicate the FMD.

Conclusion: Outbreaks in the buffer zone occasionally occur due to contact of cattle with buffalo from the KNP. However, the DAH has measures in place that effectively mitigate the risk that FMDV will be introduced into the export zone of the country from the buffer zone.

3. *Outbreaks in the export zone due to illegal movement of animals for contract feeding and conflict of interest issues*

The DAH detected, controlled and eradicated FMD in this zone, disease tracing was performed, and identification of the source of the outbreaks was determined. In addition, the DAH identified and mitigated the risk of illegal movement of animals for contract feeding and conflict of interest issues in the future. The mitigations taken by the RSA include an intensive training program of all Provincial Veterinarians that are allowed to certify statements and the creation of a National Auditing Program to audit the certification procedures and the level of knowledge of the certifying officials. In addition the VPN's regarding registration of farms and certification by veterinarians has been updated to correct the weaknesses detected on the procedure.

Conclusion: The DAH established procedures that mitigate the risk of illegal movements of animals from the buffer zone and the KNP into the export zone of the country.

4. *Outbreaks in the export zone due to the lack of enforcement of regulations prohibiting swill feeding of international waste*

The DAH detected, controlled and eradicated FMD in this zone, disease tracing was performed, and identification of the source of the outbreaks was determined. Furthermore, the DAH implemented control measures for international waste, including the creation of a protocol on swill management that was implemented at ports of entry to mitigate the risk of illegal swill feeding derived from international galley waste.

Conclusion: The DAH established procedures to mitigate the risk of diversion of international waste in the future that could be used as swill feeding to premises that maintain livestock.

5. *Lack of experience detecting FMD*

Previous to the 2000 outbreaks, FMD had not been seen in the export zone since 1957. The outbreaks in 2000 provided first-hand experience to over 800 veterinarians and AHTs in the detection, response and handling of FMD. In addition, the DAH trains veterinary personnel in the diagnosis and management of the disease. Furthermore, the DAH implemented several initiatives as control measures against FMD such as public extension to the community and farmers. These measures created awareness of the consequences of a FMD outbreak.

Conclusion: Experience detecting signs of FMD has significantly increased after the outbreaks of 2000/2001, and with the further implementation of an intensive training program of personnel. The risk of missing FMD clinical signs in FMD susceptible animals is considered to be minimal.

6. *Lack of biosecurity procedures addressing human movements and contaminated clothing*

DAH officials acquired experience during the outbreaks in 2000/2001 applying movement controls, and created procedures to prevent the spread of the FMDV due to contaminated clothing during the control of an outbreak.

Conclusion: The implementation of these procedures would reduce the likelihood that movement of personnel would cause spread of the FMDV due to contaminated clothing while conducting disease control activities during an outbreak.

APHIS mitigations: Any ruminants, ruminant meat, and other meat products of ruminants from the RSA exported to the U.S. as a result of trade reinstatement with the RSA will originate only from the export zone which is the area of the RSA that excludes the buffer zone and the KNP. Meat exports from the export zone of the RSA must meet the requirements listed in 9 CFR section 94.11 and a certification by a full-time salaried veterinary officer of the RSA will be required to state that the meat or other animal products did not originate or were not commingled with other meat or other animal products from outside the export zone of the country.

Because the RSA is considered affected with ASF, classical swine fever, and swine vesicular disease, fresh (chilled or frozen) pork cannot be imported from the RSA into the United States. If exports of meat or other animal products from any other region of the RSA that is not the export zone to the U.S. are ever expected, these must meet the requirements listed in 9 CFR, section 94.4 for cured or cooked meat, sections 94.8 and 94.9 and 94.12 for pork and pork products,

Release assessment conclusion

FMD is endemic in buffalo in the KNP. The DAH regionalized the RSA and established buffer zones to prevent the entry of FMDV from FMD-infected areas such as the KNP

and neighboring countries into a specific region established for international trade purposes. This region is the area of the RSA that excludes the buffer zone and the KNP (i.e. the export zone).

APHIS considers the buffer zone around the KNP and that extends along the borders with neighboring countries as an adequate zoning measure taken by the DAH in order to maintain the FMD-free status of the export zone of the country.

With the successful eradication of FMD in the export zone and subsequent measures implemented in response to the outbreaks, APHIS could not find additional risk factors applicable to the area of the RSA that excludes the buffer zone and the KNP that would justify keeping this region of the RSA from the list of regions APHIS considers as FMD-free.

Exposure assessment [4, 21, 22, 23, 24]

An exposure assessment as defined by OIE describes the biological pathway(s) necessary for exposure of animals and humans in an importing country to the hazards released from a given risk source, and estimates the probability of the exposure(s) occurring. APHIS' regulatory authority is limited to animal health; therefore potential risks to animals are the primary focus of this evaluation.

APHIS considers that the most likely pathway of exposure of domestic livestock to FMD virus in meat (pork or beef) and meat products is through feeding of contaminated food waste to swine. Other exposure pathways are more direct and include contact with imported infected live animals or contact with infected genetic material.

1. Waste-feeding practices in the United States

The likelihood of exposure of susceptible species to FMDV-infected meat was evaluated in previous APHIS studies. In 1995, APHIS conducted a pathway analysis to estimate the likelihood of exposing swine to infected waste. The analysis included two pathways for exposure of swine to contaminated waste; namely, exposure associated with illegal household imports, and exposure associated with legal imports. The latter is the exposure pathway that would be applicable to importing meat or meat products from RSA. With 95% confidence, APHIS estimated that 0.023% or less of plate and manufacturing waste would be inadequately processed prior to feeding to swine. Based on this fraction, less than 1 part in 4,300 (reciprocal of 0.023%) of imported meat is likely to be fed to swine as inadequately cooked waste.

APHIS conducted a survey in 2001 of the U.S. swine waste-feeding sector to update a similar study done in 1994. Based on this survey, APHIS Veterinary Services estimated that the proportion of plate and manufacturing waste fed to swine diminished by about 50% between 1994 and 2001 due to a decrease in the number of waste-feeding premises. The study also found that:

1. Several more states prohibited feeding food wastes to swine;

2. The number of waste-feeding premises in the continental United States decreased by 40.5% from 1994-2001, and in Hawaii and Puerto Rico decreased by 37.5% and 52.3%, respectively; and
3. Institutions and restaurants provide nearly 90% of all plate waste fed to swine.

APHIS considers that prohibiting the feeding of unprocessed plate waste to swine has further contributed to the reduction of waste-feeding to swine. In this regard, waste-feeder operations must be licensed and inspected regularly by USDA inspectors (9 CFR 166). The licensing process requires that producers adequately cook the waste fed to swine according to methods designed to reduce the probability of survival of foreign animal disease agents in the waste.

Based on the 1995 estimate that a very small proportion of food waste is inadequately processed prior to feeding to swine, and the substantial reduction in waste-feeding operations in recent years, APHIS considers the likelihood of exposure of susceptible swine to FMD virus through inadequately processed food waste to be low. Based on the results of the release assessment, APHIS further considers the probability of exposure of susceptible swine to these viruses through inadequately cooked FMD-infected meat from RSA to be low.

2. Imported live animals

The likelihood of exposure of susceptible species to infected live animals was evaluated by briefly reviewing virus persistence and shedding in live swine and ruminants, as well as standard import requirements for these species. The exposure assessment focuses on breeding animals since APHIS considers transportation costs to be burdensome and prohibitive for export of other live animals (e.g. feeder pigs or cattle) to the United States from RSA. Similarly, APHIS considers exposure of a susceptible U.S. animal population to illegally imported infected live animals from RSA to be highly unlikely.

Upon exposure to FMD, up to 50% of ruminant animals may become carriers of FMD virus. The maximum reported duration of the carrier state is 3.5 years in cattle, 9 months in sheep, and 4 months in goats. Carrier virus is fully infectious and consequently the carrier state is associated with at least a theoretical risk of introducing FMD into a susceptible population.

Consequently, APHIS considers this potential pathway for disease introduction to carry an inherently high unmitigated risk. Current U.S. regulations require certification that ruminants and swine have been kept in a region entirely free of FMD for 60 days prior to export (9 CFR 93.405 and 93.505) and also require a minimum quarantine of 30 days for most imported ruminants (9 CFR 93.411) and 15 days for all imported swine (9 CFR 93.510) from the date of arrival at the port of entry. These requirements serve to partially mitigate the risk of exposure by increasing the probability of disease detection.

Based on the results of the release assessment, APHIS considers the probability of exposure of susceptible animals to FMD virus via this pathway to be very low. The importation of live swine into the United States from the RSA would be prohibited because APHIS considers RSA affected with CSF, SVD, and ASF. Therefore, if trade is

reinstated with the RSA, this action would only remove the FMD restrictions from the importation of live ruminants. However, the presence of other diseases or conditions foreign to the United States would need to be considered for the importation of live ruminants. Therefore, the likelihood of exposure of susceptible U.S. ruminants or swine to FMD virus via infected ruminants from RSA is low.

3. Imported genetic material

Genetic materials have been implicated in the introduction of foreign animal disease into susceptible populations, as well as the spread of established disease epidemics over considerable distances. FMD virus may be present in semen up to 4 days before clinical signs become apparent.

Based on the extended period of survival of FMD virus in frozen semen, APHIS considers there is a likelihood of exposure of susceptible animals to this virus in infected semen. However, APHIS considers exposure of a susceptible U.S. animal population to illegally imported infected semen from the RSA to be highly unlikely. Furthermore, and based on the results of the release assessment, APHIS considers the probability of exposure of susceptible animals to FMDV via infected semen imported from the RSA to be low. In addition, mitigation measures for ruminant and swine embryos and semen listed in 9 CFR 98 subparts A and C serve to partially mitigate the risk of exposure by increasing the probability of disease detection. Therefore,, the likelihood of exposure of susceptible animals to FMDV via semen or embryos from the RSA is very low.

Exposure Assessment Summary

Based on pathway analysis conducted by APHIS, the likelihood of exposure of susceptible swine to FMDV through inadequately processed food waste to be low due to factors such as a very small proportion of food waste is inadequately processed prior to feeding to swine, and the substantial reduction in waste-feeding operations in recent years. Based on the results of the release assessment, APHIS further considers the probability of exposure of susceptible swine to these viruses through inadequately cooked infected meat from RSA to be low.

In addition, APHIS considers the likelihood of exposure of susceptible U.S. ruminants or swine to FMD virus via infected ruminants from RSA to be low. Current U.S. regulations require certification that ruminants and swine have been kept in a region entirely free of FMD for 60 days prior to export (9 CFR 93.405 and 93.505) and also require a minimum quarantine of 30 days for most imported ruminants (9 CFR 93.411) and 15 days for all imported swine (9 CFR 93.510). These requirements serve to partially mitigate the risk of exposure by increasing the probability of disease detection prior to export and during quarantine in the United States.

Based on the results of the release assessment, APHIS considers the likelihood of exposure of susceptible animals to FMD virus via infected semen imported from RSA to be low. Further mitigation measures for ruminant and swine embryos and semen listed in 9 CFR 98 subparts A and C serve to partially mitigate the risk of exposure Therefore,,

the likelihood of exposure of susceptible animals to FMDV via semen or embryos from the RSA is very low.
Ultimately, the requirements in 9 CFR 94.11 mitigate the risks associated with less restrictive trade practices by (1) restricting the sourcing of ruminants meat for export; (2) prohibiting commingling of live animals, meat, or meat products for export with such commodities from regions not considered free of these diseases; and (3) requiring exporting slaughter establishments to be approved by USDA, Food Safety and Inspection Service. An official veterinarian of the exporting country must certify that these conditions have been met.

Consequence assessment [25-38]

A consequence assessment describes the biologic and economic consequences of introducing the hazards under consideration into the United States. This consequence assessment addresses both direct and indirect consequences as recommended by the OIE.

Although any introduction of FMD would be catastrophic, the precise magnitude of the biologic and economic consequences following an introduction of FMDV would depend on the location of the introduction, the virus serotype introduced, the rate of virus spread and whether other environmental conditions at the introduction site that might facilitate this spread, ability to detect the disease rapidly, livestock demographics and movement patterns, and the ease of employing eradication procedures [25]. In addition, depending on the extent of export of livestock and their products, trade restrictions imposed by trading partners may result in severe economic consequences.

Direct consequences include effects of the disease on animal health and the subsequent production losses, the total costs of control and eradication, the effect on the environment, and public health consequences. Indirect consequences include impacts on international trade and associated domestic consequences.

1. Effects on animal health and production

FMD causes significant distress and suffering to animals regardless of the size and sophistication of their livestock unit. Very high mortality rates in young animals can occur, particularly among pigs and sheep. [26] In pigs, Dunn and Donaldson (1997) [27] estimated a general mortality rate of 40% for two outbreaks in Taiwan in 1997. Geering (1967) [28] cites mortality rates of 40, 45 and 94% of lambs in several outbreaks. Mortality in older animals occurs less frequently but may be significant with certain virus strains.

FMD causes significant losses in the production capacity of affected animals. Productivity losses of 10 to 20 percent are reported in FMD-infected livestock [25] if the disease is allowed to run its course. For example, the drop in milk yield of dairy cattle averages approximately 25% per year. [29] In addition, FMD can cause reduction in the growth rate of animals raised for meat. According to Doel (2003) [30], estimates vary considerably but one study has indicated that cattle would require approximately 10-20% longer to reach

maturity. The comparatively greater severity of FMD in pigs would imply at least similar losses to those described for cattle. [30]

2. Control and eradication costs

The overall cost of control and eradication depends on the mitigation or policy option chosen to control and eradicate the disease. Potential costs include disease control measures such as imposing quarantine measures and movement controls, direct costs related to stamping out of affected and other herds, indemnity payments, vaccination costs, surveillance and laboratory testing amongst others. For countries like the United States that have a substantial export market for livestock and livestock products, the preferred option for control and eradication has traditionally been to stamp-out infected herds without the use of vaccine.

The U.S. policy for most significant foreign animal disease emergencies is to follow strict quarantine measures and stamping-out of infected and contact herds with ongoing assessment for the need for and implementation of strategic vaccination as, in the case of the export zone of the RSA. It is difficult to predict the extent of any outbreak that might occur if FMD virus was introduced into the United States, but the cost of control, eradication and compensation would likely be significant.

A few studies have estimated the potential consequences of an FMD outbreak in the United States. In fact, results from a FMD simulation model were used to estimate the direct costs associated with indemnity, slaughter, cleaning and disinfecting livestock premises for various vaccination and eradication strategies to control transmission of FMDV in a cattle population of 2,238 herds and 5 sale yards located in 3 counties of California [31]. The study found that mean herd indemnity payments were USD 2.6 million and USD 110,359 for dairy and non-dairy herds, respectively. Cleaning and disinfection costs ranged from USD 18,062 – 60,205 per herd. The mean vaccination cost was USD 2,960 per herd and the total eradication cost ranged from USD 61 million – 551 million depending on eradication strategy.

At the national level, a comprehensive study was conducted to assess the potential economic impact of FMD in the whole of the United States [25]. The study estimated the direct costs (control and eradication program costs) and increased costs borne by consumers of FMD introduction over a 15-year period (1976-1990). Using the Consumer Price Index to update to 2001, the estimated total cost of a strict quarantine and slaughter policy was USD 34.4 million [32].

3. Effect on the environment

Environmental effects have been considered under applicable environmental review laws in force in the United States. These are considered in a separate environmental assessment conducted for the original proposed rule published on April 17, 2000, in the *Federal Register* (64 FR 7816 -7822, Docket No. 98-029-1). The environmental assessment and finding of no significant impact were in compliance with the National Environmental Policy Act and implementing regulations. [33]

4. Effect on public health

FMD may rarely affect humans. The number of cases reported is so small when compared with the number of persons exposed that FMD is generally not considered a threat to humans. FMDV has been isolated and typed in only 40 patients during the last century. Symptoms in humans are mostly mild and mainly include fever, and blisters on the hands, feet, mouth, and tongue. Patients usually recover within a week after the last blister formation. [34]

5. Indirect consequences

In addition to the direct costs of FMD introduction, impacts on international trade and related domestic consequences need to be considered. Export losses due to restrictions imposed by trade partners on FMD-susceptible animals and products can run into billions of US dollars. The value of U.S. exports of beef products alone, which would be immediately lost, was over US$3 billion in 2001. The impact of an outbreak of FMD on the rural and regional economic viability, including businesses reliant on livestock revenue, could also be substantial.

In 2002, Paarlberg et al. [35] conducted a study to estimate the potential revenue impact of an FMD outbreak in the U.S. similar to the one that occurred in the United Kingdom. The study suggested that greatest impact on farm income would be due to loss of export markets and the decrease in demand by consumers. For example, losses of gross revenue for the animal sector were as follow: cattle (17%), beef (20%), milk (16%), swine (34%), pork (24%), sheep and lambs (14%), and sheep and lamb meat (10%). Thompson et al (2002) [36] estimated the loss of about 20% of the estimated total income from farming in 2001 because of the FMD outbreak in the United Kingdom.

Japan, Korea and Mexico constitute the three major U.S. export markets for ruminant products. The value of lost exports to these three ruminant markets would total $3 billion annually if trade restrictions were enforced against the U.S.: Japan ($1.2 billion); Mexico ($1.12 billion); and South Korea ($712 million). Indirect economic losses to U.S. firms that support ruminant exports to these three markets would equal an additional $2.5 billion annually. The magnitude of these values reflects both animal and product exports. [37]

More than 33 thousand full-time U.S. jobs, accounting for almost $1 billion in wages annually, could be jeopardized by loss of these three markets. In the longer term, if trade restrictions persisted and alternative export markets did not develop, the U.S. ruminant production sector could contract, allowing other supplying countries to establish trade relationships in the absence of U.S. supply. [37]

Other losses due to restrictions on live swine, pork, and pork products are likely to be significant as well. The U.S. exports of pork and pork products are estimated at $2.2 billion dollars in 2006. [38] Since the U.S. exports only small amounts of lamb and mutton, economic losses associated with these commodities are not likely to be significant compared to cattle and swine.

Risk Estimation

Risk estimation consists of integrating the results from the release assessment, exposure assessment, and consequence assessment to produce overall measures of risk associated with the hazards identified at the outset. Thus, risk estimation takes into account the whole risk pathway from hazard identified to the unwanted event (OIE Article 1.3.2.4).

APHIS concludes from the release assessment that there is no evidence that FMD currently exists in the area of the RSA that excludes the buffer zone and the KNP, and recognizes this region of the RSA as the export zone. APHIS considers the risk potential for introduction of FMD from the export zone of the RSA into the United States via export of ruminants and ruminant products, including semen and embryos, to be low. The importation of live swine and certain swine products would continue to be restricted because APHIS considers the RSA as affected with CSF, SVD, and ASF. Due to trading practices with other regions that the United States considers affected with FMD, the importation of ruminant meat from the RSA would need to be certified in accordance with 9 CFR 94.11. As to the importation of embryos and semen, we believe that the current requirements in 9 CFR 98 subparts A and C, respectively, include adequate provisions for ensuring that FMD and other diseases that may be present in the RSA are not introduced into the United States via embryos or semen.

APHIS concluded based on previous studies that the animal health and economic consequences of an FMD outbreak would be severe. Although control and eradication measures would be costly, the major economic impact would likely result from export trade losses.

However, APHIS concludes from the exposure assessment that the probability of exposure of susceptible U.S. livestock to the FMDV via ruminants, ruminant meat and meat products, or genetic material from the export zone of the RSA is low. APHIS considers that the requirements listed in 94.11 regarding the importation of ruminant meat would mitigate the risk even further.

In summary, although an FMD outbreak in the United States would be likely to have severe animal health and economic consequences, APHIS considers the risk of infected ruminants, meat or other meat products entering the United States from the export zone of the RSA and exposing U.S. livestock to be low.

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Figure 2. Map indicating the regions in South Africa affected by the FMD outbreaks during 2000/2001 and the tracing investigation results

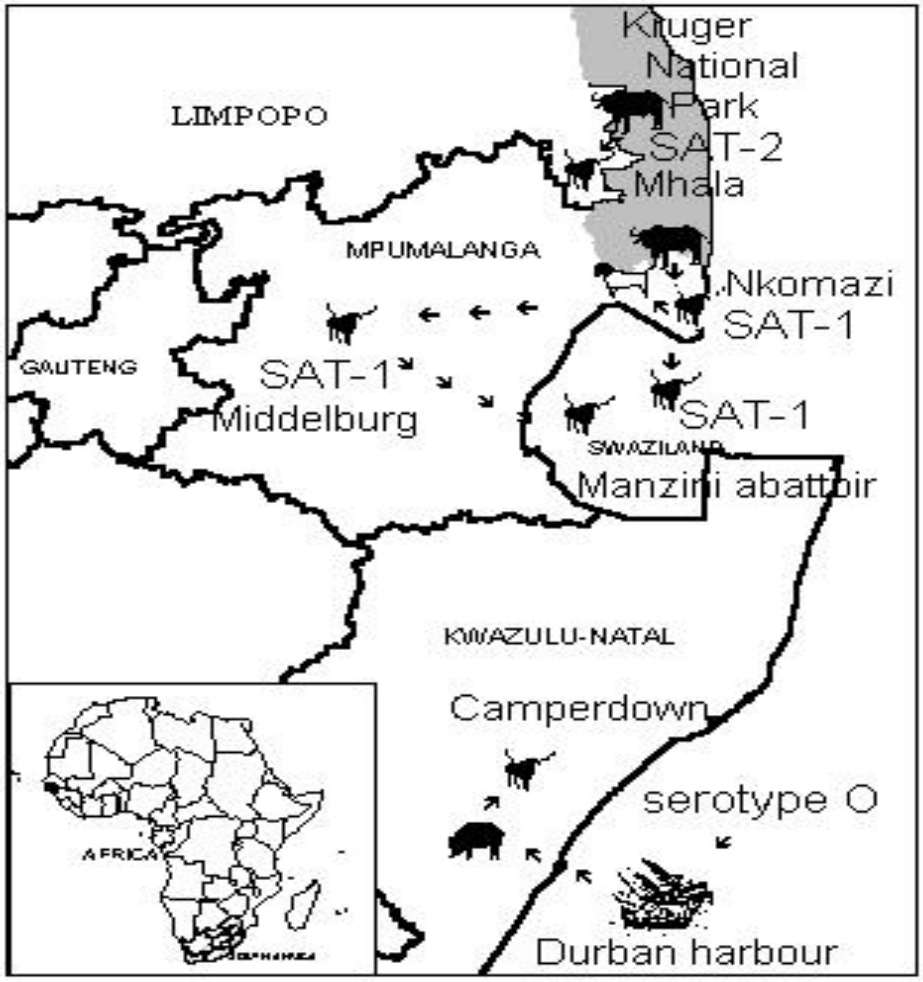


Figure 3. Map of the locations of the FMD outbreaks in the Mutale District in Limpopo Province in 2003

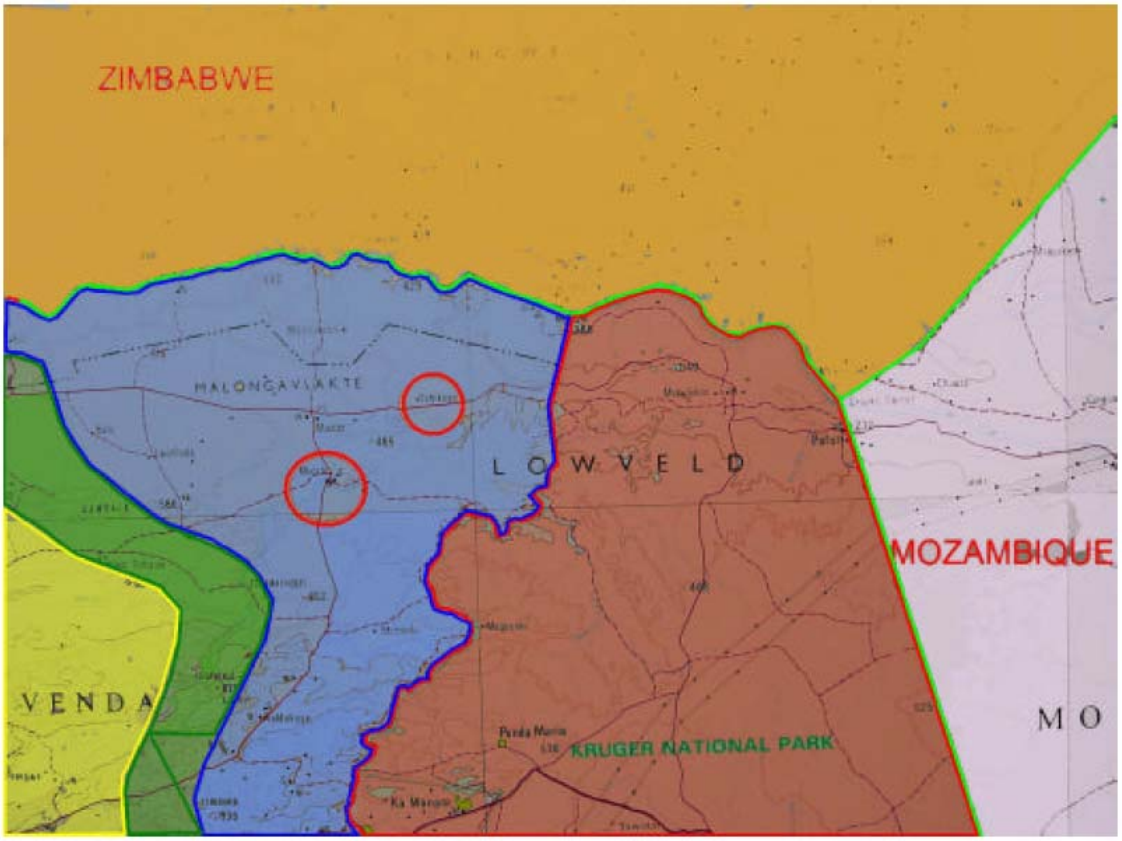


Figure 4. Map of the surveillance and quarantine areas of the outbreaks in the Limpopo Province in June 2004.

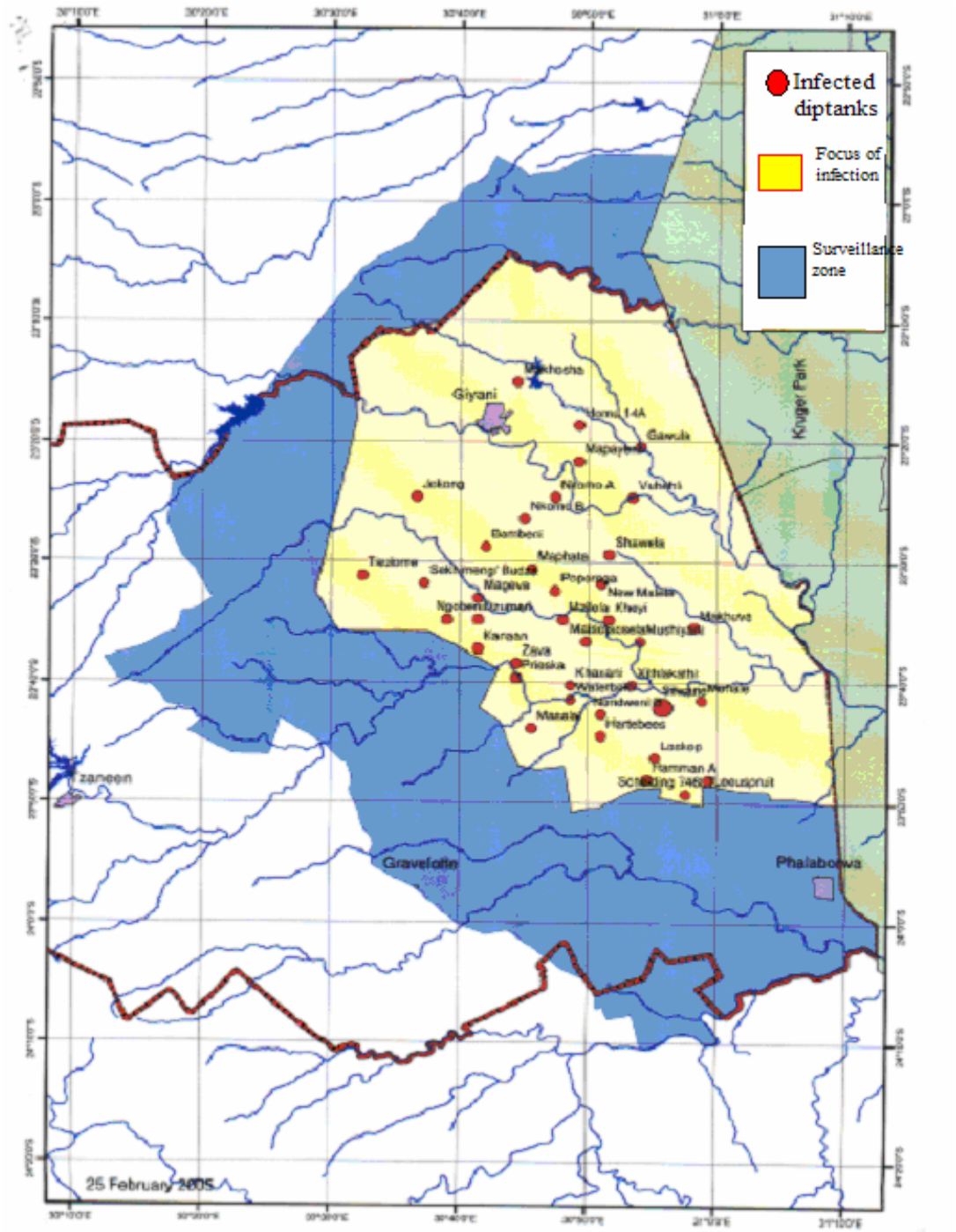


Figure 5. Map of the location of the FMD Outbreak in Malamulele, Limpopo Province in July 2006.

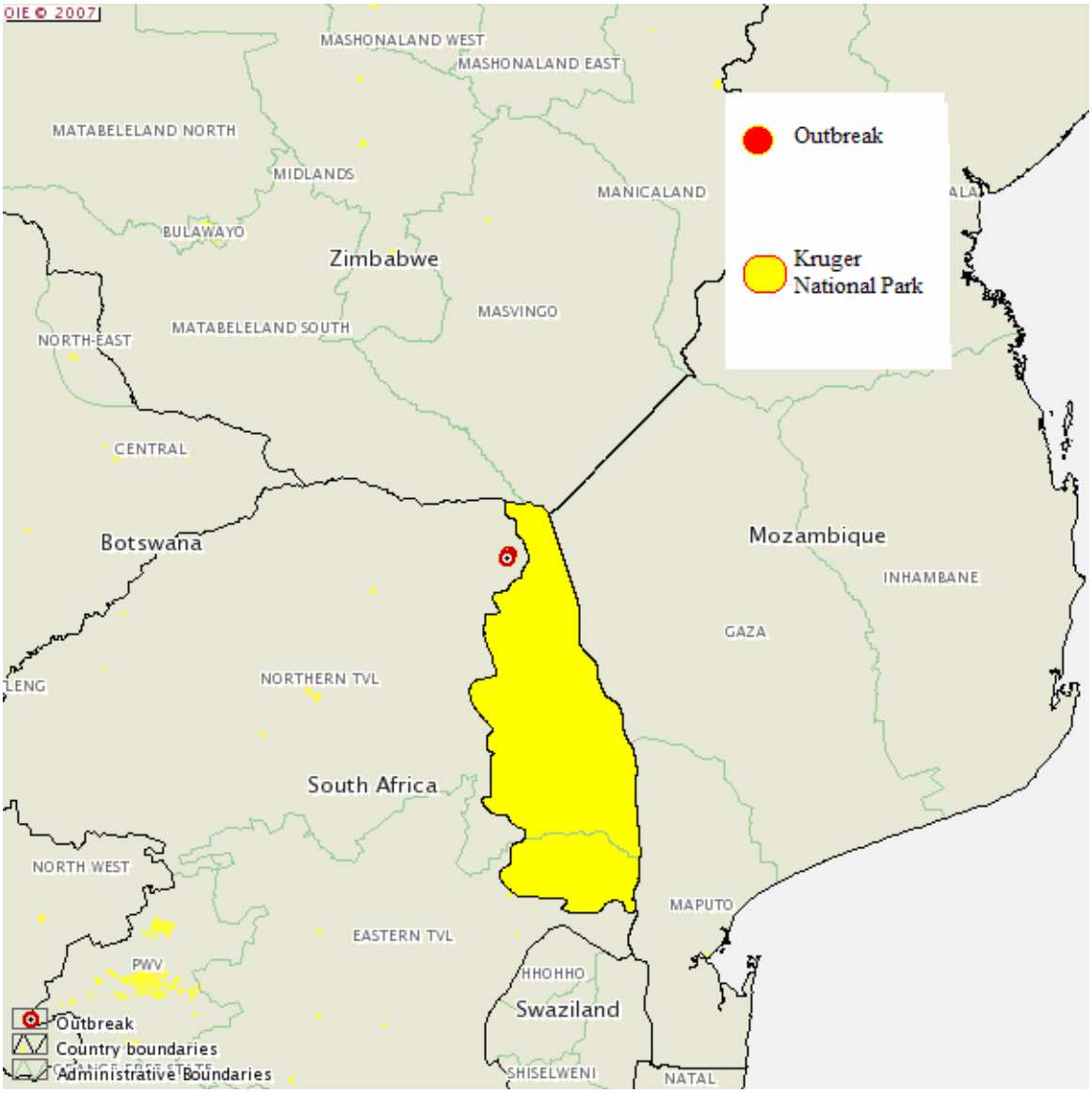


Figure 6. Map of the inspection points of the 2005 strategic FMD Survey in the buffer zone of the RSA

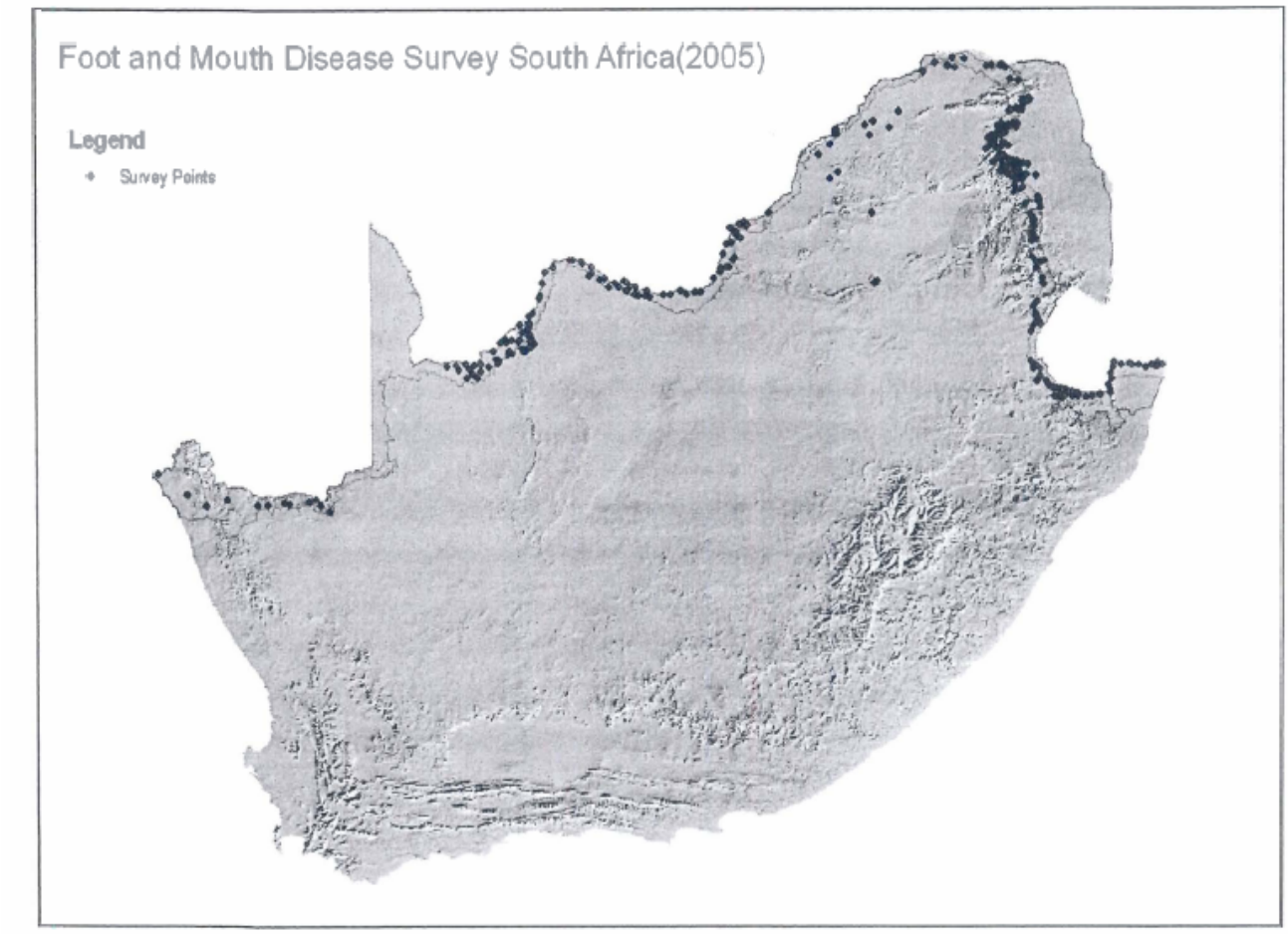


Figure 7. Maps of the location of KwaZulu-Natal Province and the quarantine and surveillance zones during the outbreak in Mpumalanga

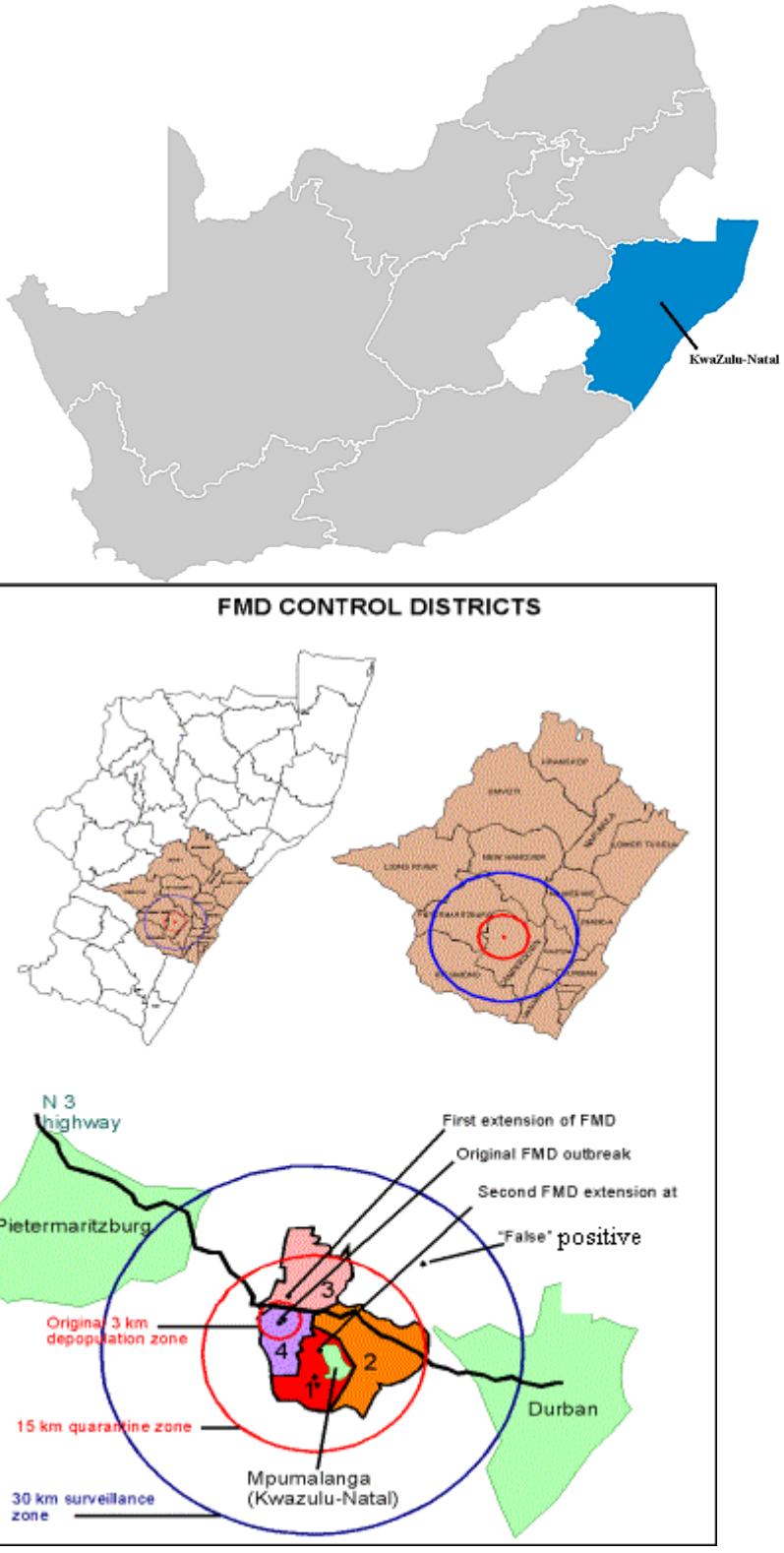
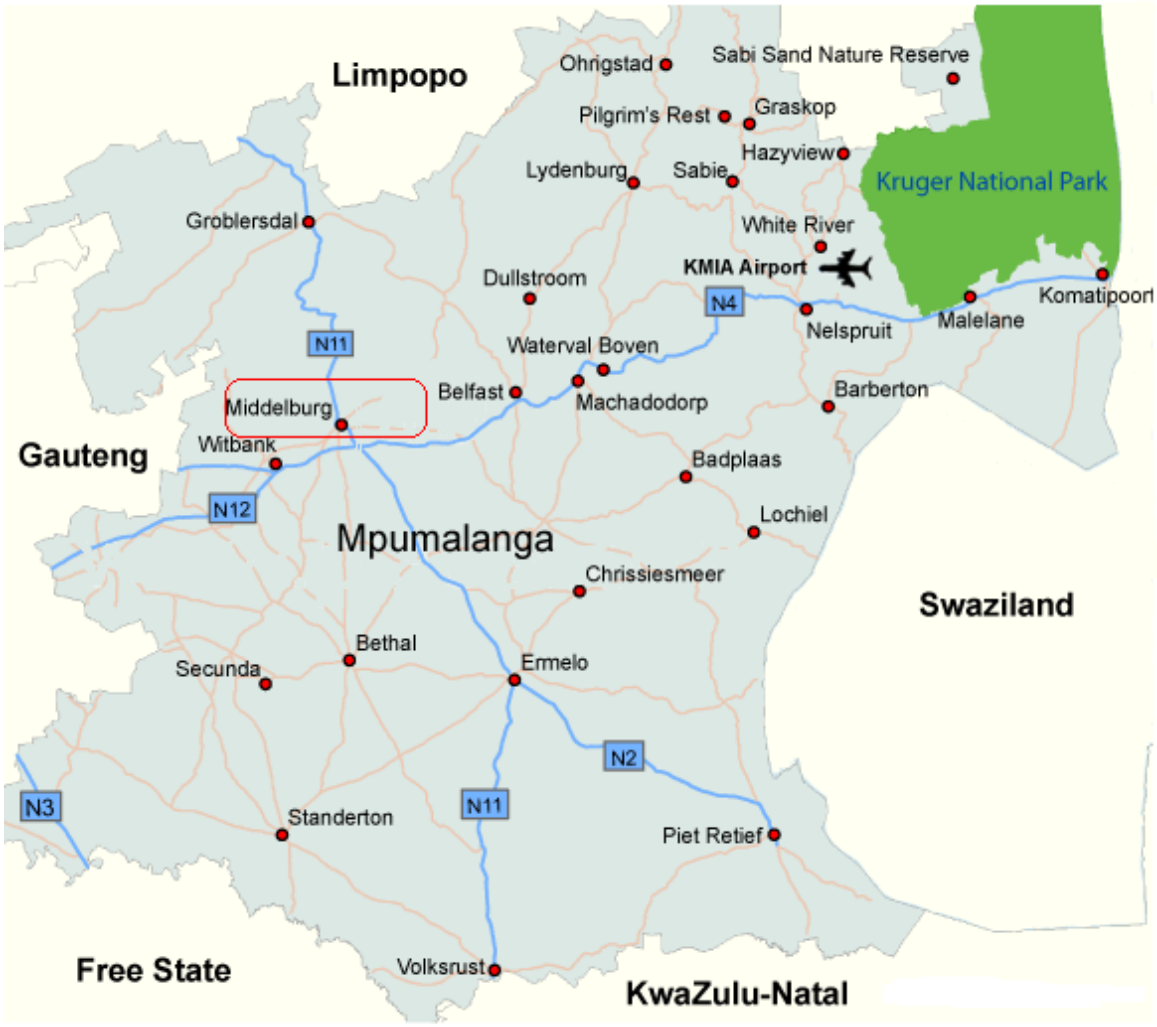


Figure 8. Map of Middelburg District, Mpumalanga Province



Appendix 1. Epidemiologic characteristics of foot-and-mouth disease (FMD)

Etiologic Agent
Family *Picornaviridae*, Genus *Aphthovirus*, types O, A, C, SAT 1, SAT 2, SAT 3, and Asia 1.

Status in the United States
FMD virus (FMDV) was eradicated from the United States in 1929.

Epidemiology
FMD is a highly communicable disease of cloven-hoofed animals caused by an *Aphthovirus* of the family Picornaviridae. FMD has seven immunologically distinct serotypes (O, A, C, SAT1, SAT2, SAT3, and Asia 1). The O, A, and C serotypes have historically been found in South America [1]. Research indicates that one serotype does not confer protective immunity against the other six, thus a disease outbreak can be caused by one serotype or a combination of serotypes [2].

FMDV can be transmitted by direct or indirect contact or aerosol. Fomites (such as feed, drinking water, tools, animal products, as well as human clothing, transportation vehicles, rodents, stray dogs, wild animals, and birds) can transmit FMD over long distances. The five main elements that influence the extent of FMD spread are: (1) the quantity of virus released; (2) the means by which the virus enters the environment; (3) the ability of the agent to survive outside the animal body; (4) the quantities of virus required to initiate infection at primary infection sites; and (5) the period of time the virus remains undetected [3, 4].

The incubation period of the FMDV is 2-14 days in cattle, depending on the viral strain and dose and the level of susceptibility of the animal [5]. Morbidity in unvaccinated herds can be high, but mortality usually does not exceed 5 percent. If it occurs during the calving season, calf mortality can be considerable [6]. Young claves may even die before the development of clinical signs usually because the virus attacks the heart muscles [5].

The respiratory tract is the usual route of infection in species other than pigs. Infection can also occur through abrasions of the skin or mucous membranes. In cattle and sheep, the earliest sites of virus infection and possibly replication appear to be in the mucosa and the lymphoid tissues of the pharynx. Following initial replication in the pharynx, the virus then enters the bloodstream. Viremia in cattle lasts for 3 to 5 days; as a result, the virus spreads throughout the body and establishes sites of secondary infections [7].

FMDV localizes in various organs, tissues, body fluids, bone marrow, and lymph nodes [8, 9]. Viral replication may reach peak levels as early as 2 to 3 days after exposure [10, 11]. Virus titers differ in different organs or tissues. Some tissues, such as the tongue epithelium, have particularly high titers. Recent data indicate that the most viral amplification occurs in the stratified, cornified squamous epithelia of the skin and mouth (including the tongue). Although some viral replication also occurs in the epithelia of the pharynx, the amount of virus produced there is apparently much less than the amount

produced in the skin and mouth during the acute phase of the disease. By comparison, the amount of virus (if any) produced in other organs like salivary glands, kidneys, liver, and lymph nodes is negligible [10, 11].

Immunity to FMD is primarily mediated by circulating antibodies [12]. The host reaction, including antibody production, occurs from 3 to 4 days after exposure and usually clears the virus, except in carriers. In infected pigs, the virus is cleared in less than 3 to 4 weeks. In contrast, around 50 percent or more of cattle will develop a low-level persistent infection, localized to the pharynx [13-15]. According to Alexandersen (2002) [12], a model for progression of infection can be described as follows: first, virus exposure and accumulation of virus in the pharyngeal area are followed by initial spread through regional lymph nodes and via the blood stream to epithelial cells. This is followed by several cycles of viral amplification and spread [12].

Clinical signs in cattle during acute infection include fever, profuse salivation, and mucopurulent nasal discharge. The disease is characterized by development of vesicles on the tongue, hard palate, dental pad, lips, muzzle, gum, coronary band, and interdigital spaces. Vesicles may develop on the teats. Affected animals loose condition rapidly, and there is a dramatic loss of milk production [5]. The animal usually recovers by 14 days post infection provided no secondary infections occur [7].

Diagnosis of the disease relies heavily on recognizing clinical signs. In unvaccinated cattle and pigs, the clinical signs are obvious. However, in small ruminants the disease is often subclinical or is easily confused with other conditions. In addition, in endemic regions, clinical signs in partially immune cattle may be less obvious and could pass unnoticed [5]. Virus isolation and serotype identification are necessary for confirmatory diagnosis. The clinical signs of FMD are similar to those seen in other vesicular diseases. Differential diagnosis of vesicular diseases includes vesicular stomatitis, mucosal disease of cattle, bluetongue, rinderpest, and FMD. Serological diagnostic tests include the complement-fixation test, virus neutralization test, and an enzyme-linked immunosorbent assay test. Other diagnostic tests include one- or two-dimensional electrophoresis of the viral DNA, isoelectric focusing of the viral structural proteins, or nucleotide sequencing of the viral RNA [4].

FMDV is a relatively resilient virus. It can survive up to 15 weeks in feed, 4 weeks on cattle hair, and up to 103 days in wastewater. The survival of the virus in animal tissues is closely associated with the acidity of that tissue. For example, in muscular tissues the acidity of rigor mortis, which occurs naturally, inactivates the virus. The production of lactic acid in these tissues during maturation is considered to be the primary factor for inactivation [16]. An acid environment where the pH is less than 6.0 will destroy the virus quickly [16, 17]. Several studies showed that in tissues where no acidification occurs (e.g., lymph nodes, bone marrow, fat, and blood), the virus may survive for extended times in cured, uncured, and frozen meat [9, 16-19]. Heating at 50° C [20] and up to 155° F [21] will inactivate the virus.

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Appendix 2. Movement restrictions of red cross permits

Red Cross Permit

A red cross permit is only used issued when animals or animal products to be moved are potentially infected and therefore subject to one or more restrictions en route or at final destination. An ordinary permit is issued for all other movements that are subject to veterinary movement permit control.

Red cross permits are used for:

1 When quarantine or retention at destination is required.
2. Movements from the index farm, the KNP, or buffer zones in one State veterinary (SV) area to any destination in the same or another SV area.
3. Movement from the index farm, the KNP, or buffer zones to a designated abattoir for direct slaughter.
4. All movements of live buffalo. warthoas, bushpigs and wild pias.

Requirements that must be complied with for a red cross permit movement:

1. For movements from one SV area to another SV area, written proof of no objection must be obtained from the relevant PEO(s) at destination.
2. In the case of livestock, the herd from which the animals originate, has to be inspected by a veterinary official within the preceding seven days (from the KNP and/or buffer zones) or 14 days (from a enhanced surveillance zone around a quarantine zone). If not, the herd must be inspected on the day on which the movement takes place.
3. All cattle that have to be moved from the KNP or buffer zones must be branded (or re-branded if necessary) with a permanent "F" brand on the right-hand side of the neck, including movements for direct slaughter.
4. If intended for direct slaughter at a designated abattoir, the "F" brand may be temporary.
5. The animals must be loaded under official supervision and the vehicle must be sealed by a veterinary official, except when moving from one farm / diptank area to another farm *1* diptank area in the same SV area provided that the movement is taking place under official supervision (physically accompanied by a veterinary official).
6. Livestock moving to a designated abattoir for direct slaughter or livestock and game that must be quarantined at destination or inspected or in respect of which seals must be broken, must be moved at such a time that they do not arrive at destination over weekends, outside normal work hours or on public holidays (arrivals must preferably be from Monday to Thursday so that the animals can be slaughtered, inspected, quarantined or seals be broken on a Friday at the latest).
7. The veterinary official at origin must inform the SV or veterinary official at destination either by telephone, by facsimile, or e-mail of the following information as soon as the animals have been loaded: registration number of the

truck; seal number; number of animals loaded; destination; estimated time of arrival at destination, in order to arrange with a veterinary official to receive the animals and to break the seals.

Arrangements for red cross permit movements must as far as possible be done together with routine inspection on the farm and at the diptank. For all red cross permit movements the veterinary official at destination is responsible for receiving the animals, breaking the seals and official supervision of the washing and disinfection of the vehicle at destination.

After the movement, the owner is responsible for the unloading of the animals, provision of a disinfectant approved by the SV, and washing and disinfection of the used vehicle at destination under official supervision. Any irregularities or discrepancies at origin, en route, at destination or elsewhere, of whatever nature, must be reported to the SV without delay and investigated immediately.

Appendix 3. Movement controls protocol in Kwazulu – Natal as a result of the outbreaks

ANIMAL MOVEMENT PROTOCOL
FOR FOOT AND MOUTH DISEASE CONTROL MEASURES
KWAZULU-NATAL
FMD CONTROL CENTRE

Issued on: 15 December 2000

The National Director of Veterinary Service hereby stated in terms of the Animal Diseases Act (No. 35 of 1984), control measure relating to the movement of animals and animal products into, within and out of the province of KwaZulu-Natal.

These areas within the FMD controlled area in the province have been determined for movement control purposes via: -

- The Quarantine Area is defined as the area within the Camperdown Magisterial District of KwaZulu-Natal, bordered by the N3 in the North, the R603 in the West, the D489 in the south and the western fence of the Shogweni Game Reserve and the D454 in the East. The area excludes the N3 itself.
- The FMD Surveillance Area comprises the area between the Quarantine Area and a circle of 30km radius with the centre coordinates being S 29" 47' 40", E30; 34' 49" (Killarney Valley).
- The remainder of the FMD Control Area comprises the rest of the 16 Magisterial Districts as proclaimed by Government Notice No. R970 dated 22 September 2000.

MOVEMENT CONTROL MEASURES

1. QUARANTINE AREA

1.1 Cloven-hoofed Livestock

1.1.1 No cloven hoofed livestock may be moved OUT OF the Quarantine Area until 7 days after being vaccinated and then only to a designated, registered abattoir for slaughter purposes, subject to inspection and permit control.

1.1.2 Unvaccinated cloven-hoofed livestock may be moved INTO, WITHIN and THROUGH the Quarantine Area, subject to permit control, to a registered abattoir.

1.1.3 Unvaccinated cloven-hoofed animals may be moved INTO the Quarantine Area subject to permit control, vaccination and permanent identification (i.e. "F-brand") at the premises of destination. (For exceptions see 1.1.4).

1.1.4 Seven days after being vaccinated and F-branded, cloven-hoofed animals may be moved WTHIN the Quarantine Area subject to inspection and permit control. Upon written application to the Director; Veterinary Services Kwazulu-Natal; goats that are imported into the Quarantine Area may be exempted from vaccination and special permission may be granted for such goats to be moved for slaughter purposes INTO and WITHIN the Quarantine Area.

1.2 Non-susceptible animals, plants and plant products, except hay, may be moved INTO, OUT OF and WITHIN the Quarantine Area without a permit.

1.3 Hay may be moved INTO and WITHIN the Quarantine Area without a permit. However, hay may not be moved OUT OF the Quarantine Area.

1.4 Meat and Meat Products

1.4.1 Raw meat and raw meat products, including viscera and offal, of cloven-hoofed livestock slaughtered at a registered abattoir may be moved INTO, WITHIN or THROUGH the Quarantine Area provided such movement is covered by a veterinary movement permit or a delivery note from the abattoir.

1.4.2 Raw meat, raw meat products, viscera and offal, bought at a butchery for own consumption at destination, and not exceeding 25 kg my move without a permit INTO or WITHIN the Quarantine Area provided such movement is covered by an invoice, receipt of purchase or a delivery note.

1.4.3 Only raw meat, raw meat products, viscera and offal of a cloven-hoofed animal originating from within Quarantine Area, that were slaughtered at a designated, registered abattoir, may move OUT OF the area, but NOT out of the Province.

1.4.4 Processed meat products, including biltong, may be moved INTO, WITHIN, THROUGH and OUT OF the Quarantine Area without a permit.

1.4.5 Hides and skins originating from cloven-hoofed livestock may be moved OUT OF the Quarantine Area in either wet-blue or salted form (salting process; sea salt containing 2% sodium carbonate for 28 days), subject to permit control.

1.4.6 Product in the form of carcass, blood, bone or abattoir meal, originating from cloven-hoofed animals and processed at a registered sterilizing plant, may b e moved INTO, WITHIN, THROUGH and OUT OF the Quarantine Area, subject to permit control.

1.5 Milk and Milk products

1.5.1 Raw milk from unvaccinated cloven-hoofed animals within the Quarantine Area may NOT be moved.

1.5.2 Raw milk that originates from cloven-hoofed animal OUTSIDE the Quarantine Area may be moved THROUGH the Quarantine

Area or to milk depots within the Quarantine Area in a selected truck, subject to permit control.

1.5.3 Milk originating from vaccinated cloven-hoofed animals within the Quarantine Area may be moved to a milk depot WITHIN or OUT OF the Quarantine Area from 7 days after all such animals on the farm have been vaccinated. All such movement is subject to permit control.

1.5.4 High temperature pasteurized milk and dairy products derived from (cheese, butter, maas, yoghurt, ice-cream, etc.) may be moved INTO, WITHIN, THROUGH, and OUT OF the Quarantine Area without permit control.

1.6 Game

1.6.1 Clove-hoofed game species may be moved INTO or THROUGH the Quarantine Area, subject to permit control.

1.6.2 Cloven-hoofed game species will NOT be allowed to move WITHIN or OUT OF the Quarantine Area.

1.6.3 Processed game trophies and treated skins of cloven-hoofed game species may be allowed to move INTO, WITHIN, THROUGH and OUT OF the Quarantine Area, subject to permit control.

1.6.4 Meat and meat products originated from cloven-hoofed game species may be moved INTO the Quarantine Area, subject to permit control., such products may NOT be moved WITHIN or OUT OF the Quarantine Area, except for biltong in break-dry form.

1.7 Genetic Material

1.7.1 Semen originating from cloven-hoofed animals may be moved INTO and WITHIN the Quarantine Area, without a permit. Movement of semen THROUGH and OUT OF the Quarantine Area is subject to written permission being granted by the Director: Veterinary Services, KwaZulu-Natal.

1.7.2 Ova and embryos originating from cloven-hoofed animals may be moved INTO and WITHIN the Quarantine Area, without a permit. Movement of ova and embryos THROUGH and OUT OF the Quarantine Area is subject to written permission being granted by the Director: Veterinary Services, KwaZulu-Natal.

2. FMD SURVEILLANCE AREA

2.1 For any areas or premises of the Surveillance Area, that have been or will be designated for vaccination, the same rules apply as for the Quarantine Area (1.1 to 1.7).

2.2 Cloven-hoofed animals may move INTO and THROUGH the Surveillance Area subject to permit control.

2.3 Cloven-hoofed animals may only be moved OUT OF the Surveillance Area directly to an abattoir subject to inspection and permit control.

2.4 Cloven-hoofed animals, NOT destined for an abattoir may be moved OUT OF the Surveillance Area at the discretion of the Director: Veterinary Services KwaZulu-Natal.

2.5 Movement of cloven-hoofed animals WITHIN the Surveillance Area is subject to inspection and permit control. Vaccinated cloven-hoofed animals may only be moved to other premises with vaccinated animals.

2.6 Raw milk may NOT be moved OUT OF the Surveillance Area, unless it is taken to a milk depot, subject to permit control.

2.7 Processed milk and dairy products, as well as meat and meat products derived from a registered abattoir, may be moved INTO, WITHIN or OUT OF the Surveillance Area without a permit. However, products of cloven-hoofed animals originating from within the Quarantine Area may NOT be moved OUT OF the Province (see Paragraph 4.3.2 below).

3. REMAINDER OF THE FMD CONTROL AREA

3.1 There is a prohibition on the export of cloven-hoofed animals, there products arising therefrom and their genetic material from the 16 Magisterial Districts of the FMD Control Area, as specified in Paragraph 5 below.

3.2 Cloven-hoofed animals may be moved INTO, WITHIN and OUT OF the FMD Control Area without permits. However, any movement of the cloven-hoofed animals OUT OF the Province of KwaZulu-Natal is subject to inspections and permit control (see Paragraph 4.3.1 below).

3.3 Products of cloven-hoofed animals, their genetic material, and other agricultural products such as hay may be moved INTO, WITHIN and OUT OF the FMD Control Area without permit control. However, products of cloven-hoofed animals originating from within the Quarantine Area may NOT be moved OUT OF the Province (see Paragraph 4.3.2 below).

4. REMAINDER OF THE PROVINCE OF KWAZULU-NATAL

4.1 Export from the remainder of the Province

Exports of cloven-hoofed animals and their products may be considered from the remainder of the Province, providing that the requirements as stipulated by the importing country are complied with at all times.

4.2 INTO and WITHIN the remainder of the Province

Cloven-hoofed animals, all products derived from cloven-hoofed animals, their genetic material and other agricultural products such as hay may be moved INTO and WITHIN the remainder of the Province without permit control.

4.3 OUT OF the remainder of the Province

4.3.1 Cloven-hoofed livestock and game may be moved OUT OF the remainder of the Province subject to inspections and permit control.

4.3.2 Products of cloven-hoofed animals originating from within the Quarantine Area may NOT be moved OUT OF the Province.

4.3.3 All products of cloven-hoofed animals originating from outside the Quarantine Area , their genetic material and other agricultural

products such as hay may be moved OUT OF the remainder of the Province without permit control.

5. GOVERNMENT NOTICE No. R970 dated 22/09/2000

In terms of the Animal Disease Act (Act 35 of 1984) and Government Notice R970 of 22 September 2000, the following 16 Magisterial Districts are declared Foot and Mouth Disease Control Areas:

SV PIETERMARITZBURG
Pietermaritzburg
Richmond
Camperdown
Kranskop
Umvoti
New Hanover
Lions River

SV VERULAM
Mapumula
Lower Tugeia
Ndwedwe
Inanda

SV Durban
Pinetown
Durban
Umbumbulu
Chatsworth
Umiazi

7. EXEMPTIONS

Applications for exemption from the movement control as listed above may be made, in writing, to the Provincial Director of Veterinary Services, ; Private Bag X2, Cascades, 3202.

NATIONAL DIRECTOR, VETERINARY SERVICES

Appendix 4. Movement controls protocol in Middelburg as a result of the outbreak

NOTICE
FOOT AND MOUTH DISEASE OUTBREAK, MIDDELBURG
MOVEMENT PROTOCOL

A. **INFECTED AREA** (Kanhym Estates – Cattle and sheep feedlot and piggery-Arendsfontein)

1. **Animals and Products**

a. Animals and Animal products

- No animals or animal products may move into or out of this area.
- No animals or animal products maybe moved between the piggery and the cattle/sheep feedlot.

b. **Products of plant origin**

- Only raw material of plant origin intended for feed production may be allowed into the infected area.
- Only feed of plant origin may leave the infected area.

This is feed for the poultry industry and feed intended for use at the piggeries at Kanhuym Estates (Arendsfontein and Wanhoop). Movements of these products will take place under cover of an invoice, which will be inspected at the inspection point entering the piggery or when leaving the quarantine zone through any of the inspection points.

2. **Vehicles**

- At the entrance gates of the feedlot and the piggery vehicles will be disinfected under veterinary supervision with an approved chemical. All vehicles will be disinfected on entering and leaving.
- Dedicated light delivery vehicles must stay in the infected area.

3. **People**

- No unauthorized people may enter the infected area.
- On entering and leaving shoes and gumboots must be disinfected with an approved disinfectant.
- All staff will be dedicated to a unit; either the feedlot, the mill or the piggery and be identified by overall colour. It is imperative that this is strictly controlled and adhered to.
- All workers at the feedlot and the piggery will have to shower in and out at the facilities as provided.

B. **QUARANTINE ZONE**

1. **Animals and Animal products**

- No cloven-hoofed animals may move into, out or through the quarantine zone.
- Movements of the commercial breeding herd on Kanhym Estates may only be executed in consultation with veterinary officials.

- Animal products may not move out of the quarantine zone except:
  - Milk treated according to OIE specifications.
  - Products originate from outside the quarantine zone on condition that a permit is obtained on entry of the quarantine zone.
- No animal products may enter the quarantine area except for transit (if declared) and for consumption within the area, provided that it was sourced from an area free of foot and mouth disease restrictions.

2. **Vehicles**
   - For movement of vehicles through or in the quarantine zone please refer to the attached document. (Procedures for control points in Middelburg-Mpumalanga FMD area).

3. **Feed**
   - No feed for susceptible animals may leave the quarantine zone.

C. **SURVEILLANCE ZONE**

No movement control or restrictions will take place in the surveillance area.

Appendix 5. Returned or confiscated material at International Ports and Border Posts for 2002, 2003 and 2004

Live animals and larger quantities of specific products that arrived at the border post without the necessary import documentation was refused entry. These include:

- Meat products
- Milk products
- Dogsand other companion animals
- Goats and sheep

Confiscated material at Beit Bridge Border Port

Material	2002	2003	2004
Meat (Kg)	4,251	12982	11,049
Milk (liters)	2,931	3,914	5,095
Cheese (Kg)	178	396	335
Butter (Kg)	99	257	102
Biltong (Kg)	1,232	4,420	850
Cooked Meat Products (No.)	1792	1,3564	621
Artefacts containing animal parts	1,478	2,280	2,355
Grass Products (No.)	8,082	3,978	4,686
Travellers			
Entering RSA from Zimbabwe	1,058,306	982,390	986,378

Lembobo Border Post

Material	2002	2003	2004
Meat (Kg)	225	1658	1330
Meat products (Kg)	117	2,225	1,507
Milk (Liters)	221.1	767	311
Milk powder (Kg)	111	1,051	605
Skins & products (No)	8	213	103
Grass products	479	2,421	1,924
Live goats (No.)	-	2	1
Travellers	61,424	1,354,904	830,713

International Airport of Johanesburg
Up to November 2004 no records were kept. As from the first of December 2004 dogs are used to detect prohibited material and records are kept of all confiscated material.

At none of the other ports of entry records of confiscated material are kept. Products from these ports are not considered a risk for introduction of FMD. These materials are burnt at the site.